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REPORT

of

THE NORTH CAROLINA SALT MARSH MOSQUITO STUDY COMMISSION

Raleigh, North Carolina
January 1957

SALT MARSH MOSQUITO STUDY COMMISSION

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MANTEO

The Honorable Luther H. Hodges
Governor of North Carolina
State House
Raleigh, North Carolina

Dear Governor Hodges:

In compliance with Chapter 1197 of the 1955 Session Laws of North Carolina, we, the members of the Salt Marsh Mosquito Study Commission, have the honor to submit to you, and through you to the General Assembly of North Carolina, the report of this commission.

Respectfully submitted,

Charles M. White

Charles M. White, Chairman
C. B. Davis, M. D., Vice-Chairman
Yates M. Barber, Jr.
Col. B. C. Snow
Charles J. McCotter
Edward G. McKinley
W. W. Johnston, M. D.

REPORT OF

THE NORTH CAROLINA SALT MARSH

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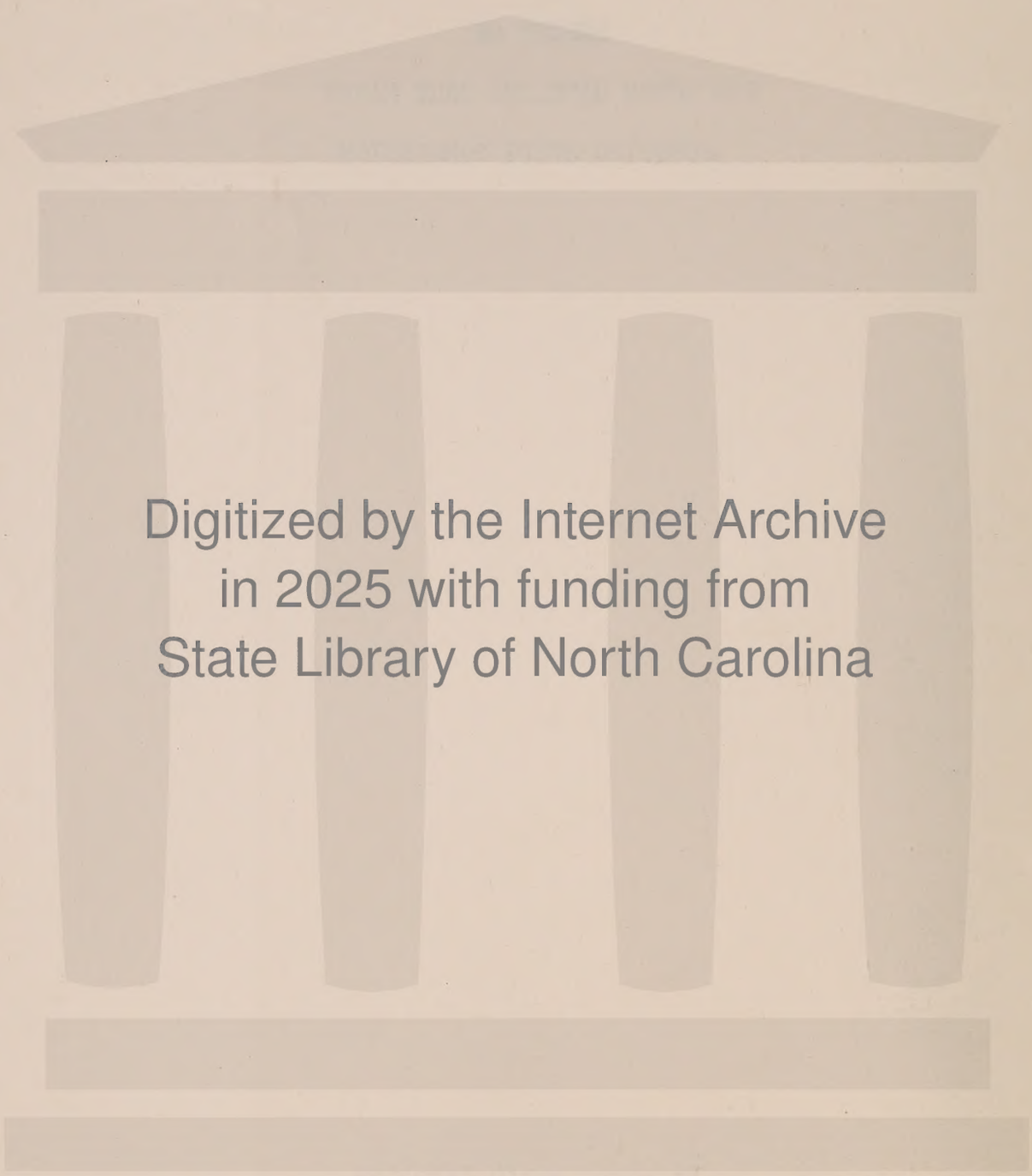

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SUMMARY AND CONCLUSIONS

1. Salt marsh mosquitoes lay their eggs on the ground in areas that are slightly higher in elevation than normal high tides. The eggs may remain dry for months and still retain their viability. When the eggs are flooded by heavy rains or abnormal tides, the eggs hatch into larvae. After a few days these change into pupae, and the adult mosquitoes emerge from the pupae. When favorable conditions occur, eggs that have accumulated for months may hatch almost simultaneously, thus causing a heavy infestation of mosquitoes.

2. Salt marsh mosquitoes are strong fliers and fierce biters that normally fly as much as ten miles from their breeding places, and at times for thirty miles or more.

3. The engineering survey, made by this Commission, shows that there are 416,614 acres of salt marsh in Eastern North Carolina. This includes 82,815 acres in which the timber was killed by salt water blown in by the recent hurricanes.

4. Data collected on the entomological survey, made by this Commission, disclose that vast numbers of salt marsh mosquitoes develop in all counties along the eastern seaboard when weather conditions are suitable.

5. Salt marsh and other species of mosquitoes are a menace to the health of people who live in the parts of North Carolina in which these insects breed in large numbers. Human cases of malaria still occur in the State, and encephalitis, another mosquito-borne disease, was widespread in Eastern North Carolina during 1955. Cases occurred in humans, equine animals, and domestic pheasants. An estimated 500 horses and mules were killed during this outbreak.

6. Fresh water mosquitoes transmit all of the mosquito-borne diseases that occur in North Carolina, and are found in all areas that have salt marsh mosquito problems. The control of these mosquitoes is necessary to achieve desired results on any mosquito control program.

7. In addition to transmitting disease organisms, mosquitoes adversely affect human health by causing secondary infections brought on by mosquito bites, and by lowering physical efficiency and comfort upon which mental equanimity depends to a large degree.

8. In Eastern North Carolina, salt marsh mosquitoes have retarded economic progress by hindering agricultural operations; causing drastic reductions in the number of tourists and vacationists who visit the area, and shortening the length of stay by those who do visit; presenting an unfavorable factor to be considered by those who are planning the establishment of industry; and by retarding the sale and development of real estate.

9. Even though a reservoir of malaria still remains in the State, this disease has been brought under control, thus demonstrating that mosquito control operations directed at a specific species, and applied in accordance with proved technical and scientific methods, can be effective.

10. There are three standard methods of mosquito control: larviciding, adulticiding, and permanent control. The first is directed against the immature forms of mosquitoes in the water; adulticiding, as the term implies, means killing adult mosquitoes; and permanent control includes such measures as filling, draining, and dyking.

11. During 1955, a total of $307,232.69 in local and Federal funds was allocated for mosquito control, and in 1956 the amount of these allocations was $282,279.85. State allocations for these years were $32,886.00 and $57,400.00, respectively. Operations demonstrated that by space spraying to kill adult mosquitoes effective control could be obtained under favorable conditions, and that this method of control, though expensive, is practical for the protection of heavily populated areas. It was also demonstrated that large scale larvicidal operations are neither practical nor effective when applied against salt marsh mosquito larvae until detailed entomological data that specifically delineate the breeding areas are available.

12. In some states where DDT or other chlorinated hydrocarbons have been used to a large extent for both larviciding and adulticiding, the species of mosquitoes being controlled develop resistance to the chemical used.

13. There is a great need for research in the ecology of salt marsh mosquitoes, in order that knowledge comparable to that now available concerning malaria mosquitoes may be obtained. More effective and economical control techniques should be developed. The Commission believes that these are proper functions of the Federal Government, as all states with salt marsh mosquito problems could benefit therefrom.

14. Mosquito control operations by the Federal Government on national parks and military installations in North Carolina are limited to the protection of individuals on Federal property.

15. In order to satisfactorily accomplish mosquito control, operations and planning should be continued throughout the year.

16. Beach erosion and other factors that facilitate the intrusion of sea water increase the salt marsh mosquito breeding potential.

17. California is spending $3,900,000.00 annually for mosquito control in state and local funds. Florida spends $3,398,690.00, Virginia $408,500.00, South Carolina $249,920.00, and New Jersey

$1,560,000.00. Other states report large expenditures, but the exact amount for both state and local funds was not given. Most of these states have statutory provisions for the organization of mosquito control districts that have power to levy taxes.

18. Beaufort, Carteret, Craven, Pender, New Hanover, Onslow, Pasquotank, and Brunswick counties are capable of financing mosquito control programs that would include all standard methods, if help on a fifty-fifty basis is provided by outside sources.

Chowan, Washington, Jones, and Perquimans counties have no salt marshes, but are annoyed by mosquitoes that fly in from the outside, as well as fresh water species that originate within their borders. These counties, with outside help on a fifty-fifty matching basis, could finance appropriate control measures.

The economic conditions in Dare, Currituck, Camden, Hyde, Tyrrell, and Pamlico counties are such that it is not believed that at this time they would be capable of financing mosquito control operations that include all methods, even if outside help is provided on a fifty-fifty basis.

19. The collection of sufficient data to determine the control plan and cost of operations for the State as a whole, or any specific areas, was not practical with the time and facilities devoted to this survey. Based on information obtained from other salt marsh mosquito control projects in which there was an extremely wide variation in cost, it is indicated that approximately $8,332,280.00 would be required to control mosquito breeding in the 416,614 acres of salt marshes in North Carolina with drainage, filling, and dyking.

20. The North Carolina State Board of Health has, within its organization, an Insect and Rodent Control Section composed of an engineer and entomologist who, in addition to having scientific academic training in mosquito control, have spent years in this activity. The personnel of this section planned and supervised the activities that resulted in bringing malaria under control. They supervise all mosquito control for which the State Board of Health is responsible, and serve as consultants to all local programs.

21. The preservation of good hunting and fishing is vital to the future development of Eastern North Carolina. Hunting, as well as both sport and commercial fishing, is and has been for a long time an important source of livelihood. This makes it imperative that in all control operations consideration be given to the protection of these and other natural resources.

22. In order for localities to be empowered to effectively organize, with full authority to levy special taxes, employ personnel, enter into contracts, and perform other functions necessary to the control of mosquitoes, legislation should be passed that provides for the organization of mosquito control districts.

RECOMMENDATIONS

A. Research and Demonstration

Because of the lack of reliable knowledge concerning the ecology of salt marsh mosquitoes, and the need for developing more economic and effective control techniques, it is recommended that:

1. Adequate provisions be made for continued research in the breeding, flying, biting, and other habits of salt marsh mosquitoes.

2. Experimental pilot projects be put in operation for each of the methods now regarded as permanent types of salt marsh mosquito control, which include drainage, filling, and dyking, for the purpose of determining:

(a) The comparative effectiveness of mosquito control achievable;

(b) The comparative per-acre cost of initial development, and subsequent maintenance;

(c) Necessary modifications of respective control methods under various ecological conditions common to North Carolina coastal areas; and

(d) The effects of the various methods on flora and fauna common to the treated and adjoining areas, with particular reference to wildlife, seafood, marsh plants, forest, and water resources.

3. Experimental projects be conducted for each of the temporary types of salt marsh mosquito control, which include larviciding and adulticiding, for the purpose of determining:

(a) The comparative effectiveness of each method with the various insecticides, dispersal methods, and techniques now employed;

(b) The comparative per-acre cost of each method under the various conditions that prevail;

(c) The comparative cost and effectiveness of temporary control methods versus permanent control methods; and

(d) The effects of the various methods on the health and comfort of the human population, as well as on plant and animal life.

4. Efforts be made to develop more effective and cheaper salt marsh mosquito control methods.

B. Investigation and Survey

Because of the need for more complete knowledge with respect to conditions that influence the breeding and other habits of salt marsh mosquitoes in North Carolina, it is recommended that the study be continued.

C. Proposed Mosquito Control Programs

The ultimate goal of all salt marsh mosquito control programs in North Carolina should be the elimination of salt marshes, or the modification of these marshes in such a manner that they will no longer breed salt marsh mosquitoes.

The engineering survey shows that there are 416,614 acres of these marshes in the State, and that the cost of rendering them unsuitable for salt marsh mosquito propagation would be approximately $8,332,280.00. Approximately three-fourths of these marshes lie in the six counties that are lowest in economic status. Still another factor that will necessarily delay the achievement of the goal is the lack of detailed engineering and entomological information.

In order that mosquito control programs may be operated that are consistent with the financial capacity of the counties, cities, and towns in Eastern North Carolina, it is recommended that:

1. All areas with concentrations of human population that are affected by mosquitoes in such a manner as to menace the public health, or to an extent that cause a major annoyance, apply mosquito control measures commensurate with their ability to finance these measures.

2. Camden, Hyde, Tyrrell, and Pamlico counties continue and expand the application space spraying to kill adult mosquitoes.

3. Currituck and Dare counties continue and expand the application of space spraying to kill adult mosquitoes; perform minor drainage to destroy mosquito breeding areas immediately adjacent to resort areas, and other centers of population; and to seek means whereby additional revenues may be obtained from tourists, vacationists, and sportsmen who would benefit by mosquito control in these counties, in order that funds may be provided for permanent control measures.

4. Chowan, Washington, Jones, and Perquimans counties continue and expand the application of space spraying to kill adult mosquitoes. Salt marsh mosquitoes do not breed in these counties, but fly in from the outside. If contiguous counties form mosquito control districts, and engage in permanent control, these counties should help pay the cost in proportion to the benefits received.

5. Beaufort, Carteret, Craven, Pender, New Hanover, Onslow, Pasquotank, and Brunswick counties, being regarded as capable of financing all standard methods of mosquito control with outside help on a fifty-fifty matching basis, immediately take steps for the initiation of programs that would include selective larviciding, as well as permanent control methods. This program should be made operative as soon as sufficient entomological and engineering data pertinent to specific local conditions are available. These counties, or parts of these counties acting separately, or in combination with contiguous counties, or contiguous parts of such counties, should form mosquito

control districts, in order that the necessary organization, and other facilities that will be required for gathering detailed specific information and performing control operations, can be provided.

6. All counties that have salt marsh mosquito problems explore the possibility of revising their present tax structures, or finding new sources of revenue, in order that complete mosquito control activities may become feasible.

D. Financing

This commission believes that the primary responsibility for initiating and financing mosquito control activities is that of the local people, and recommends that local funds be provided for that purpose through local appropriations, or by the organization of mosquito control districts with authority to levy taxes. It is recognized, however, that the magnitude of the problem involving salt marsh mosquitoes, and other species of these insects, makes it imperative that consideration to its solution be given on both State and Federal levels.

To provide outside help with which to assist localities in financing mosquito control measures on a matching basis, and to provide for research, demonstration, and pilot projects, it is recommended that:

1. The legislature appropriate sufficient money for the fiscal years 1957-58 and 1958-59 to provide for the necessary administrative, scientific, and supervisory personnel on a State level, and to provide funds with which to give aid to localities on a fifty-fifty matching basis for temporary mosquito control. It is estimated that $150,000.00 annually will be needed for these two years.

2. Subsequent legislatures appropriate sufficient funds to provide for the necessary administrative, scientific, and supervisory personnel on a State level; and to provide funds with which to match local funds expended for temporary mosquito control on a fifty-fifty basis, and to match such funds expended on permanent control on a basis whereby the State would provide twice the amount provided locally. The amount needed will depend on progress made by localities in the initiation and expansion of mosquito control programs.

3. The Federal Government continue to provide funds with which to assist localities in the control of mosquitoes that occur as a result of hurricanes, or other disasters. This recommendation is not limited to disasters that might occur in the future. It also applies to the rectification of conditions caused by hurricanes Connie, Dianne, and Ione. It is estimated that $1,656,300.00 would be required to drain the additional 82,815 acres of mosquito breeding areas created by these hurricanes.

4. The Federal Government conduct research, demonstration and pilot projects that are needed to learn more about mosquitoes, and to

show how they can be more effectively controlled; or grant money to the State for that purpose.

In the event no Federal money is made available for these activities, State funds should be used.

5. Federal help be sought in providing funds with which localities may conduct mosquito control operations near national parks, military installations, and other federally-owned property where mosquitoes are a problem; and that the Federal Government eliminate by standard permanent control measures, or otherwise satisfactorily treat mosquito breeding places on Federal property in which mosquitoes breed that endanger the public health, or cause annoyance to the civilian population that lives near the government-owned property.

E. Administration

In order that State funds spent for mosquito control may be utilized in the most efficient and effective manner, and in accord with methods recommended by the United States Public Health Service, the North Carolina State Board of Health, and other recognized authorities; that uniform procedures be followed; and that control be exercised with regard to the possible damage to fish, wildlife, and other fauna and flora, full control with regard to the allocation and expenditure of State funds must be maintained on a State level. In order that this may be accomplished, it is recommended that:

1. The present funds and facilities allocated to the Salt Marsh Mosquito Study Commission for mosquito control be transferred to the North Carolina State Board of Health; and all subsequent appropriations or allocations for mosquito control be made to the North Carolina State Board of Health, as that agency has an Insect and Rodent Control Section that for a number of years has been engaged in the planning and supervision of mosquito control activities, which would serve as a nucleus for the expanded activity. Establishment of the program within the State Board of Health would preclude the creation of a special agency for salt marsh mosquito control.

2. Legislation be passed that provide for the organization of mosquito control districts that would be located and operated in accordance with plans approved by the North Carolina State Board of Health. Proposed legislation may be found in the last section of this report.

3. The Salt Marsh Mosquito Study Commission be retained for the purpose of continuing the study of mosquito problems, and to act in an advisory capacity to the North Carolina State Board of Health in all matters relating to salt marsh mosquitoes.

F. General

1. It is recommended that funds appropriated for mosquito con-

trol be made available to help localities in the control of mosquitoes that breed in fresh water, as well as those that breed in salt water, when outbreaks of mosquito-borne diseases occur, or when these species are breeding in sufficient quantities to constitute a major annoyance.

2. It is recommended that no DDT or other chlorinated hydrocarbons be used as salt marsh mosquito larvicides to avoid building up resistance to these materials by mosquitoes of these species.

3. It is recommended that full consideration be given to the preservation of natural resources in the planning of any mosquito control program, with special reference to wildlife, fish, shell-fish, crustaceans, soil, water, and timber.

ACTIVITIES OF THE COMMISSION

CALENDAR YEAR 1955

The following members of the Salt Marsh Mosquito Study Commission were appointed by Governor Hodges:

Dr. W. W. Johnston, Manteo
Charles J. McCotter, Bayboro
Edward G. McKinley, Morehead City
Dr. C. B. Davis, Wilmington

The following ex-officio members were selected by the heads of their respective agencies:

Charles M. White, N. C. State Board of Health
P. A. Griffiths, N. C. Department of Conservation and Development
Yates M. Barber, Jr., N. C. Wildlife Resources Commission

At the first meeting, held in Raleigh on July 5, 1955, Charles M. White was elected chairman, and HenreEtta Owen, secretary of the Insect and Rodent Control Section, N. C. State Board of Health, was elected secretary. At a subsequent meeting, Phillip A. Griffiths was elected vice-chairman. Mr. Griffiths resigned from the commission in July of 1956, and was replaced by Col. B. C. Snow as ex-officio member representing the N. C. Department of Conservation and Development. In September of 1956, Miss Owen resigned as secretary and Mr. Sidney H. Usry, an employee of the commission, was elected to replace her. In December of 1956, Dr. Davis was elected vice-chairman.

From the beginning and throughout the period covered by this report, the State Health Officer and other officials of the N. C. State Board of Health co-operated to the fullest extent with the newly-formed commission. Quarters were provided, professional and clerical assistance made available, and other services, including those provided by the department's budget officer, were placed at our disposal.

The primary function of the commission, in accordance with the legislative act responsible for its creation, was to make a study of the salt marsh mosquito problem in Eastern North Carolina, and investigate the capacity of each community in the affected area to provide funds for mosquito control. The sum of $15,000.00 was provided with which to carry out this study.

Immediately following the formation of the commission, through the help of the N. C. State Health Officer, assistance was obtained from the U. S. Public Health Service in making a preliminary survey of the salt marsh mosquito problem along our coast. The official who assisted us on this survey provided his own airplane, pilot and other needed facilities. After a coverage of the entire area by air and visiting many places by

automobile, and in some cases on foot, a preliminary report was prepared with recommendations. It was estimated by him that a minium of $500,000.00 per year would be required to operate a satisfactory program directed at the control of salt marsh mosquitoes. A large part of this would be needed to perform temporary control measures, such as space spraying and larviciding, while the rest would be applied toward permanent improvements. The latter category would include drainage, dyking, and other environmental alterations. He also emphasized the need for research in the ecology of salt marsh mosquitoes and the development of more effective control methods. Much is still unknown regarding the breeding, flying and biting habits of these insects. In the case of malaria mosquitoes, scientific research and information gained in the operation of control activities in many parts of the world, during the last half century, have resulted in the collection of volumes of data, leaving little unknown about them or the most effective means whereby they can be controlled. Research, pilot projects and demonstrations along with a vast amount of experience on large scale operations will be needed before we have comparable knowledge of the salt marsh species.

Included in the act that created the commission is a provision whereby the governor and council of state are authorized to allocate from the Contigency and Emergency Fund amounts reasonably necessary to control salt marsh and other species of mosquitoes in emergencies. In August of 1955, an allocation of $15,000.00 was made and at a later date an additional amount of $2,886.00 was allocated. These allocations, with the $15,000.00 appropriated by the legislature, gave a total budget of $32,886.00 for the 1955-56 fiscal year. We were instructed to use these funds to help those who help themselves.

With such a small amount of money we were faced with the problem of determining how it could be spent to obtain maxium benefits. Consistent with the policy of helping those who help themselves, a rule was followed whereby insecticide materials were given communities that purchased or already possessed dispersal equipment; or, if the communities preferred to furnish the insecticides, the equipment would be rented by us. In either event, the labor was furnished by the locality. Table Number I shows help given localities with State funds. Where aerial spraying was performed we would, in most instances, provide the insecticides or pay the applicator. A contract price of $21.00 per hour flying time for the first hundred hours, and $19.00 per hour for additional time, was made with a registered crop duster. Control operations were initiated on August 9, 1955.

TABLE NO. I
HELP GIVEN COMMUNITIES ON MOSQUITO
CONTROL WITH STATE FUNDS
IN 1955

Recipient	Value of Help Given			
	Insecticides	Fuel Oil	Aerial Spraying	Total
New Hanover County	$ 1,980.00	$ 514.51		$ 2,494.51
Onslow County			$ 956.00	956.00
City of Jacksonville	1,936.65		420.00	2,356.65
Town of Richlands			210.00	210.00
Pender County	187.50			187.50
City of New Bern	625.00			625.00
Carteret County	1,134.00			1,134.00
Sea Level Chamber of Commerce	1,012.50		420.00	1,432.50
Pamlico County	256.20	342.50	483.00	1,081.70
Hyde County	118.80		420.00	538.80
Town of Belhaven	915.40		420.00	1,335.40
Town of Aurora			147.00	147.00
Dare County	2,415.00	572.00	288.00	3,275.00
Town of Columbia	37.80	36.45		74.25
Bladen County	502.20			502.20
Edgecombe County	178.20			178.20
Totals	$11,299.25	$1,465.46	$3,764.00	$16,528.71

Initial information obtained from questionnaires sent to towns, counties and other community organizations revealed a willingness on the part of the communities to spend slightly over $40,000.00. As many of the answers were vague or incomplete, a tabulation of these data is not feasible. The amount actually spent by them, however, was substantially increased as the season progressed.

Efforts were made to employ professional personnel, either an engineer or an entomologist with experience in mosquito control, to begin work on the study and at the same time help localities in planning and supervising control activities. The kind of person we wanted, who was willing to accept a position of uncertain duration at the salary offered, could not be found. We were fortunate in obtaining the services of a man, formerly employed as a district sanitarian by the N. C. State Board of Health, who possessed the qualifications needed to assist communities on the type of control operations being performed at that time. This sanitarian and one part-time clerical worker were the only employees paid with commission funds in 1955. Satisfactory administration of field and office activities was made possible with help given by the N. C. State Board of Health and aid provided by the U. S. Public Health Service.

TABLE NO. 2
FCDA FUNDS FOR MOSQUITO CONTROL ALLOCATED
TO TOWNS AND COUNTIES IN 1955

Recipient	Federal Funds	Local Funds	Total Funds
Dare County	$ 20,770.50	$ 1,410.00	$ 22,180.50
Elizabeth City	7,780.75	340.00	8,120.75
Carteret County	10,259.00	10,794.00	21,053.00
Hertford	5,204.00	900.00	6,104.00
Edenton	16,172.56	1,453.00	17,625.56
Duplin County	2,646.00	350.00	2,996.00
Chowan County	35,280.00	1,200.00	36,480.00
Pamlico County	7,780.00	3,874.00	11,654.00
New Hanover County	3,500.00	10,166.03	13,666.03
Columbia	3,840.00	323.00	4,163.00
Hyde County	7,160.00	3,643.30	10,803.30
Beaufort County	6,240.00	510.00	6,750.00
Washington	4,150.00	1,219.75	5,369.75
Onslow County	4,906.25	5,195.00	10,101.25
Aurora	4,800.00	3,502.75	8,302.75
Jones County	3,398.70	1,250.00	4,648.70
Swansboro	5,595.00	5,296.00	10,891.00
Craven County	6,143.75	500.00	6,643.75
Beaufort	8,308.50	9,364.25	17,672.75
Morehead City	5,495.00	2,108.75	7,603.75
Kill Devil Hills	26,773.70	2,774.15	29,547.85
Plymouth	460.00	686.00	1,146.00
Clinton	3,425.00	1,007.50	4,432.50
Brunswick County	8,381.50	5,578.00	13,959.50
Aulander	3,396.00	650.00	4,046.00
Currituck County	5,145.00	2,516.00	7,661.00
Gatesville	6,870.00	645.00	7,515.00
Colerain	5,095.00	1,000.00	6,095.00
Totals	$228,976.21	$78,256.48	$307,232.69

After hurricanes Connie, Diane and Ione passed through the state, Governor Hodges requested the Federal Civil Defense Administration to make funds available for mosquito control in affected areas, as it had been determined that the vast increase in these insects was a direct result of these hurricanes. This request was granted and General Edwin F. Griffin, Director of the N. C. Council of Civil Defense, informed us that projects for mosquito control would be accepted by his office. Again we were able to obtain aid from the U. S. Public Health Service with the help of Dr. J. W. R. Norton, our State Health Officer. Four engineers were assigned to us by that agency to assist localities in the estimation of needs, preparation of projects, training local personnel, supervision of operations and evaluation of results.

Control operations consisted primarily of space spraying to kill adult mosquitoes, with a small amount of larviciding performed by aircraft to kill immature mosquitoes in the aquatic stages, and some cleaning of

drainage ditches.

The U. S. Public Health Service also lent the State four space spray machines as well as an aircraft, and furnished 7,500 gallons of insecticides. These facilities were used primarily in areas heavily damaged by the hurricanes that were lacking in local facilities.

The urgency of the problem made it necessary that practically all resources be applied to actual mosquito control operations, thus precluding the opportunity to gather entomological or other data to the desired extent for properly evaluating the effectiveness of results. Observations of mosquito densities in areas before and after the dispersal of insecticides, talks with local officials as well as other residents, and letters received indicate that the results were governed by frequency of dispersal, amount and type of supervision given, weather conditions, topographical features and skill of the operator. Where frequent space spray coverage was given, with other conditions favorable, excellent control was obtained.

It is our belief that very little good was accomplished by the aerial application of larvicides. The salt marshes were too spacious for our facilities to cope with, thereby making complete coverage impossible. Sufficient entomological data were not available to permit selective spraying of specific areas known to be breeding mosquitoes.

The excessive abundance of mosquito populations built up following the hurricanes, coupled with warm weather during the fall months, resulted in the continuation of a mosquito problem much later in the year than is customary. In some instances this annoyance persisted until December.

Due to our inability to obtain the desired scientifically trained personnel, and the necessity for applying the greater part of existing facilities to actual mosquito control operations, made imperative by the frequent recurrence of emergency disasters, very little was accomplished in 1955 toward making the study.

In addition to several meetings held in Raleigh the commission also met in Wilmington, Jacksonville, Bayboro, Belhaven and Manteo. These meetings were well attended by county and municipal officials, civic leaders, chamber of commerce representatives, news reporters and interested citizens. Those in attendance manifested a gratifying interest in the problem and a determination to work toward its eventual correction. Members of the commission endeavored to present a clear portrayal of our purpose and activities, as well as the limitations on what we could accomplish due to the lack of resources. It was emphasized that, regardless of the type of mosquito control program that is developed for Eastern North Carolina, the initiative would have to be taken by the communities involved and financial participation provided by them.

At several meetings in the eastern section there were participants, from counties not affected by salt marsh mosquitoes, who expressed the hope that future plans would provide for the control of fresh water mosquitoes as well as those that breed in salt water. Evidence was presented

by them to show that the mosquito annoyance is about as great in many communities fifty or more miles from the coast and that the affected populations are greater.

CALENDAR YEAR 1956

Early in 1956 the sanitarian who was employed by the commission resigned to enter private business. Shortly thereafter we were successful in obtaining the services of an engineer and an entomologist, who immediately began the collection of data for this report. In addition to the work performed by them on the study, these men devoted much time to assisting communities with mosquito control programs by helping with the planning, supervision and evaluation of control operations, the selection of materials and equipment, training local personnel and preparing FCDA projects. Contacts were made by them with the U. S. Soil Conservation Service, the U. S. Corps of Engineers, the N. C. State Highway Commission and other governmental agencies in order to establish working relationship whereby the operations of these agencies can be utilized in the suppression of mosquito breeding, and to retard their creation of additional places for mosquito propagation.

On May 30, 1956 the Governor and Council of State allocated $57,400.00 to the commission, from the Contigency and Emergency Fund, for the fiscal year 1956-57. Twenty thousand four hundred dollars of this amount was to pay salaries and defray other administrative expenses, twenty-five thousand dollars to match local funds on a fifty-fifty basis for insecticides and other necessary supplies, and the remaining twelve thousand dollars was given us to use in employing three sanitary engineers for a period of five months, if anticipated federal funds were made available.

The study being made disclosed that the hurricanes of 1955 created conditions that would greatly enhance the mosquito problem in 1956 if suitable weather conditions prevailed. Many drainage systems in the salt marsh area were clogged with sand as well as fallen trees and other debris, and the intrusion of salt water further inland caused the formation of many additional places suitable for the breeding of salt marsh mosquitoes.

On May 24, 1956 Governor Hodges applied to the Federal Civil Defense for $500,000.00 for use in cleaning out drainage facilities that were blocked by the hurricanes, and space spraying to kill adult mosquitoes. In order to validate our claim that a potential hazard to the public health existed, and that it was caused by the hurricanes, the State Health Officer requested the U. S. Public Health Service to make a survey and report on conditions found. The conclusions and recommendations given in this report, which covered an investigation made from May 28 to June 1, are quoted below:

"CONCLUSIONS"

"1. Salt-marsh mosquito annoyance is very high in eastern Dare County, Hyde County, eastern Pamlico County, and eastern Beaufort County. In other coastal areas, the large overwintering populations of fresh water and salt-marsh mosquito eggs, together with the clogged conditions of

drainage streams and small salt-marsh outlet drains, create a very explosive situation where any unfavorable sequence of weather conditions could very rapidly produce large infestations of mosquitoes. The above problems resulted from the hurricanes of 1955 and were intensified by the storm of April 11, 1956."

"2. There were human cases of malaria in North Carolina in 1955. North Carolina also has a wide spread focus of equine encephalomyelitis. It is axiomatic that when insect vectors of these diseases increase, the probability of transmission is also increased if reservoirs are present."

"3. In view of the present explosive nature of the mosquito situation, an enlarged mosquito investigation and control organization and program are deemed highly advisable."

"RECOMMENDATIONS"

"1. Reduce number of mosquito vectors associated with equine encephalomyelitis and malaria.

a. Intensify larval and adult mosquito killing operations in the entire coastal area.

b. Arrange for hurricane damage drainage systems to be opened in those cases where the agricultural stream clearing projects do not correct the problems.

c. Collect mosquitoes each week for encephalitis virus determinations in order to assist in continually evaluating the possibility of encephalitis transmission. A search for virus in Aedes sollicitans and in Culex mosquitoes is particularly desirable.

d. Maintain a close malaria surveillance program with special attention to number of Anopheles quadrimaculatus in areas adversely affected by the hurricanes.

e. Employ three additional mosquito control specialists by the North Carolina State Board of Health for duty in the coastal areas, such as at Wilmington, New Bern, and Nags Head. These three persons could be assigned the job of constant evaluation of current mosquito problems and in assisting counties to intensify mosquito control efforts. These three persons would be invaluable in securing maximum mosquito control benefits from the proposed agricultural streams clearing projects."

"2. Set up an estimated minimum budget of $500,000.00 for this calendar year to finance principally the measures indicated in items a and b above."

TABLE NO. 3
FCDA FUNDS FOR MOSQUITO CONTROL
ALLOCATED TO TOWNS AND COUNTIES
IN 1956

Recipient	Federal Funds	Value of Local Participation	Total Funds
Hyde County	$ 9,500.00	$ 8,526.75	$ 18,026.75
Pamlico County	12,000.00	15,000.00	27,000.00
Carteret County	12,460.03	10,785.00	23,245.03
Dare County	14,001.78	10,170.00	24,171.78
Pender County	5,200.00	1,000.00	6,200.00
City of Washington	3,368.15	3,139.12	6,507.27
Onslow County	6,800.00	3,415.00	10,215.00
Town of Swansboro	2,000.00	1,200.00	3,200.00
Town of Plymouth	1,966.16	726.50	2,692.66
Town of Hertford	1,700.00	300.00	2,000.00
Town of Edenton	2,639.25	2,018.25	4,657.50
Town of Williamston	1,000.00	2,250.00	3,250.00
Town of Whiteville	902.20	1,155.20	2,057.40
Currituck County	5,450.00	15,210.00	20,660.00
Town of Kinston	1,000.00	21,600.00	22,600.00
Town of Jacksonville	3,000.00	3,005.00	6,005.00
Hertford County	1,500.00	805.00	2,305.00
Edgecombe County	1,000.00	2,288.00	3,288.00
Gates County	1,499.96	880.00	2,379.96
Jones County	3,000.00	1,550.00	4,550.00
Town of Columbia	2,970.00	2,405.00	5,375.00
Town of Clinton	1,087.50	3,050.00	4,137.50
Town of Burgaw	1,500.00	1,000.00	2,500.00
Camden County	3,035.00	296.00	3,331.00
Pitt County	1,000.00	14,200.00	15,200.00
Wilson County	2,000.00	5,610.00	7,610.00
Brunswick County	6,330.00	7,780.00	14,110.00
Craven County	1,500.00	1,835.00	3,335.00
New Hanover County	10,000.00	15,125.00	25,125.00
Town of Elizabeth City	2,090.00	*	2,090.00
Town of Bayboro	1,200.00	*	1,200.00
City of New Bern	1,300.00	1,955.00	3,255.00
Local and Federal	$124,000.03	$158,279.82	$282,279.85
Value of Insecticides Provided by State (Table No. 4)			24,914.52
Total for 1956			$307,194.37

* Amount of local funds not given on project

On June 20, the Federal Civil Defense Administration made an allocation of $100,000.00 to North Carolina for mosquito control. In a conference with State Civil Defense officials, it was decided that these funds would be used exclusively for adulticiding, and responsibility for determining amounts to be spent in each locality was given the N. C. State Board of Health. On November 8, we were notified that an additional grant of $25,000.00 in FCDA funds had been made.

The Salt Marsh Mosquito Study Commission adopted a policy in 1956, whereby the money allocated to them for assistance to communities with locally financed mosquito control projects would be spent for insecticides only. These materials were bought at a cheaper price on a state contract than would have been possible if each community had made separate purchases.

TABLE NO. 4
COST OF INSECTICIDES GIVEN TO LOCALITIES
BY SALT MARSH MOSQUITO STUDY COMMISSION
IN 1956

Recipient	Amount	Recipient	Amount
Town of Belhaven	$ 506.00	Jones County	$ 506.00
Town of Washington Park	205.00	Lenoir County	404.80
Town of Washington	506.00	Martin County	424.00
Brunswick County)			
New Hanover County)	3,188.60	Onslow County	985.40
Bertie County	506.00	Town of Jacksonville	1,012.00
Carteret County	1,973.40	Town of Swansboro	530.00
Town of Edenton	500.00	Elizabeth City	1,012.00
Town of New Bern	495.00	Town of Hertford	530.00
Craven County	495.00	Pamlico County	1,973.40
Dare County	2,012.00	Pitt County	358.60
Camden County	455.40	Pender County	550.00
Currituck County	495.00	City of Rocky Mount	200.00
Edgecombe County	398.60	Robeson County	391.92
Town of Gatesville	202.40	Sampson County	404.80
Greene County	367.40	Tyrrell County	506.00
Hertford County	424.00	Washington County	506.00
Hyde County	1,045.00	Wayne County	440.00
		Wilson County	404.80

Total cost of insecticides $24,914.52

In 1956, control operations were more efficiently carried out than in 1955. This can be attributed to better organization and supervision as well as experience obtained in the previous year. With few exceptions, residents of the areas involved expressed satisfaction with the protection given and gratitude for the efforts made in their behalf.

The Salt Marsh Mosquito Study Commission is fully cognizant of the limitation that can be achieved in mosquito control when all measures are directed at the killing of adult mosquitoes. We know that in a well-rounded program first consideration should be given the elimination of breeding places by drainage, filling and dyking, that larvicides should be applied to breeding areas that can not be destroyed; and space spraying to kill adult mosquitoes should be regarded as a supplementary measure, held in reserve for use when other methods fail. With meager resources at our disposal, we believe that it would not have been feasible to attempt any other measures. By performing adulticiding alone, it was possible to distribute benefits on a reasonably equitable basis throughout the area where the need existed. We hope that subsequent appropriations on local, state, and federal levels will be sufficient to justify the inauguration of completely balanced mosquito control activities in North Carolina.

FISCAL REPORT

Budget for Fiscal Year 1955-56

Item	Amount in Budget	Amount Spent	Unexpended
Salaries and Wages	$ 6,642.00	$ 6,112.02	$ 529.98
Supplies and Materials	14,492.00	14,481.75	10.25
Postage, Telephone, Telegrams and Express	184.00	90.15	93.85
Travel Expense	3,775.00	3,342.74	432.26
Printing and Binding	30.00	4.95	25.05
Equipment	1,326.00	1,106.19	219.81
Contractual Services	3,764.00	3,764.00	
Motor Purchase	2,450.00	2,285.76	164.24
Motor Upkeep	223.00	204.84	18.16
Totals	$32,886.00	$31,392.40	$1,493.60

Budget for Fiscal Year 1956-57 (To Nov. 30, 1956)

Item	Amount in Budget	Amount Spent	Unexpended on Dec. 1, 1956
Salaries and Wages	$19,200.00	$ 6,160.81	$13,039.19
Supplies and Materials	25,000.00	23,163.61	1,836.39
Postage, Telephones, Telegrams and Express	400.00	60.42	339.58
Travel Expense	7,300.00	1,920.90	5,379.10
Printing and Binding	300.00		300.00
Equipment	300.00		300.00
Motor Purchase	1,400.00	463.20	936.80
Motor Upkeep	3,500.00	489.11	3,010.89
Totals	$57,400.00	$32,258.05	$25,141.95

LIFE CYCLE AND HABITS OF SALT MARSH MOSQUITOES AEDES SOLLICITANS AND AEDES TAENIORHYNCHUS

The Life of a Salt Marsh Mosquito.

The female mosquito deposits her eggs on moist ground in low areas which are likely to be flooded at a later date by abnormal tides such as flood or wind tides or rain water. The greatest number of eggs will be found in thick, low vegetation and where organic matter at ground surface is abundant and coarse. In North Carolina, it has been found that areas which had been flooded as a result of hurricanes and consequently have a large salt deposit in soil, served as excellent breeding grounds for mosquitoes. It takes approximately three days for the egg to change into a larva within the eggshell. These three days are extremely critical in the life of the mosquito, if conditions are ideal, then the egg is said to be "conditioned", meaning it is ready to hatch when flooded. Eggs will remain viable or alive in soil for over eight months and will hatch in any kind of water after being "conditioned". Percentage of hatch will decrease as the time interval before flooding becomes greater.

The development of the larva or "wiggle-tail" or "wriggler" may take from 5 days to 4 weeks in North Carolina. Temperature is the most critical factor and food is second. If temperature drops down considerably, larvae will become inactive and development will be almost non-existent. If the pool that larvae are living in begins to dry up, larvae will skip one stage or "period" of development. The larva grows through three sheddings of skin before it transforms into the pupal or resting stage in its life history. In the pupal stage, transformations occur internally, which change immature larva to mature adult. This stage in life history may vary from 30 hours to several days. All species of mosquitoes must spend the larval and pupal portion of their life cycle in water. Thus, all mosquitoes are partially aquatic animals.

Adults newly emerged from pupae are unable to fly. It takes from 6. to 8 hours for tissues and organs to expand, harden, and adjust so that it can fly or perform any of the usual adult activities. After hardening and expanding processes are complete, the adults take off on a migratory flight or "exodus". This flight is the result of a "migratory drive" which mosquitoes cannot resist and which cannot be interrupted or sidetracked by any of the normal desires for food, mating, etc. The migration serves no purpose as far as the individual mosquito is concerned. The flight is downwind and is usually lengthwise of the coastline rather than inland which makes it essential that any control program be a united effort of the whole seaboard. This flight can be up to 25 miles or more by females, but averages as far as is known about 8 to 10 miles. After the migratory flight is over, mosquitoes settle down to normal activities such as seeking blood-meals, resting, egg-laying, etc. However, the flights of females in normal post-migration activity may still be of considerable distance. Outbreaks of Aedes taeniorhynchus

over 45 miles inland from tidewater have been reported from Florida.

After the migratory flight is ended, male mosquitoes will tend to settle down on the edge of breeding areas, feed exclusively on nectar since they need no blood meals, "swarm" almost every twilight, travel but a few feet a day, and live a useless life. Mating occurs as soon as there is general flight activity.

When mosquitoes have done either a certain amount of flying or reached a certain age, they exhaust their energy reserves and become hungry. As stated previously, hunger leads to a nectar meal in the male. However, in the female, depending on conditions as yet unknown, hunger may lead to either a blood meal or a nectar meal. The female mosquito uses the blood in "ripening" or maturing its eggs, and obtains a great deal of energy value from nectar enabling her to fly more and live longer. Although specific studies have not been made of the length of time salt marsh mosquitoes can fly, on the basis of what is known about other mosquitoes, salt marsh mosquitoes after a nectar meal may be expected to fly about 10 hours before exhaustion.

The female's behavior follows an approximate 5-day cycle after migration. A typical cycle is for the mosquito to bite on the 3rd, 8th, and 13th days of adult life and to lay eggs on the 7th, 12th, and 17th days. On the 4th, 5th, 6th, 9th, 10th, 11th, 14th, 15th, and 16th days, it apparently is resting continuously. The female in looking for a blood meal flies about randomly or aimlessly until it strikes a scent. Once it has a scent, it has a very fixed and unchanging behavior of stimulus-reaction-stimulus-etc. chain reaction which leads to a stomach full of blood. Very little is known on how far the female will travel in search of the blood scent. Also to be considered is the fact that females when they are gravid, that is, possess eggs within their body, are attracted to light. Thus a town attracts mosquitoes both by blood scent and lights. Another factor to consider is wind direction. Most complaints about mosquitoes on the Eastern Seaboard of North Carolina occur when there is a land-sea breeze carrying mosquitoes out of marshes on to beaches or when there is no wind at all. Although much time is spent by mosquitoes in resting, there is still very little known about their resting habits. Personal observations by staff of the Salt Marsh Mosquito Study Commission indicate a wide variety of places where salt marsh mosquitoes may rest. They have been found resting in fields of crops, salt-kill areas, low shrubs, grass, and many times in well kept lawns. The shoulders of roads through marshes and marshy areas afford ideal resting areas - as any motorist who has ever had to pull off the road from Engelhard to Mann's Harbor can testify.

Another very important consideration in the life history of the mosquito is the effect a large population of mosquitoes in October would have on the number of mosquitoes in the Spring. In September and October of 1955, as a result of hurricanes, large populations of salt marsh mosquitoes were present along the entire Eastern Seaboard of North Carolina as well as being present considerable distances into the interior. Many millions of eggs were deposited during this period by the female mos-

quitoes - a large majority of which hatched out in the spring with the rain and warm temperatures. Thus, the large populations of mosquitoes which appeared in Dare, Hyde, and Carteret Counties in March and April of 1956, were to be expected as result of previous large number in 1955.

The question of how long a salt marsh adult mosquito lives is a puzzling one. It is generally estimated that the male mosquito lives two weeks and the female three weeks or better. It is also believed that the salt marsh adult mosquitoes die out in the winter, and that it is in the egg stage in which the mosquitoes spend the winter months. However, on December 25, 1955 in New Hanover County, North Carolina, the Health Department received numerous complaints from people being bitten during the day by salt marsh mosquitoes. The weather was not such that eggs and larvae would have developed during the previous week. Also, if it were merely pupae that had transformed into adults because of the unusually warm weather on Christmas Day, they would not have begun to fly until dark. It is an established fact, that the salt marsh species after transforming into adults from pupae will not fly until dusk. Yet people were being bitten during the middle of the day.

Generally speaking, the salt marsh mosquito, Aedes sollicitans, is considered to breed along the coast. Yet in the last three years both Kentucky and Illinois have reported severe localized outbreaks. This species was also reported in 1938 in New Mexico and Arkansas. No one knows with certainly what conditions enable this mosquito to breed so far inland. The minerals present in water and soil where they breed may be an important factor.

Salt Marsh Mosquitoes Compared With Fresh Water Mosquitoes.

Aedes sollicitans and Aedes taeniorhynchus, our predominant salt marsh mosquitoes, differ distinctly from fresh water species of mosquitoes in several important ways.

The flight range or dispersal distance from breeding area is far greater on the average for the salt marsh mosquitoes than fresh water forms. A fresh water species such as the malaria mosquito, Anopheles quadrimaculatus, has a flight range of about one mile while both Aedes sollicitans and Aedes taeniorhynchus average eight to ten miles and large scale flights have been recorded of over forty-five miles from the sea-coast.

The feeding activities differ widely. Fresh water species, for the most part, will be active biters at dusk, night or very early morning. Salt marsh mosquitoes will attack and bite at any time of day or night.

The salt marsh species are exceptionally robust and very strong flyers. It takes a heavy rain or strong winds to keep them from flying, whereas, a light mist might prevent the majority of fresh water species from flying. The salt marsh mosquitoes can withstand greater variances in temperature far better than fresh water forms.

FRESH WATER MOSQUITOES

Even though this commission was formed as an initial step toward finding a solution to the salt marsh mosquito problem in North Carolina, it is appropriate that a part of this report cover those species that breed in fresh water. There are over fifty known species of mosquitoes in this State, but only a few of these are found in salt water. Among the fresh water varieties are proven vectors of all indigenous mosquito-borne diseases known to affect man or animals. When considered solely from a standpoint of annoyance, the salt marsh mosquitoes are more vicious biters and fly farther, but the fresh water species are problems in a much greater part of the State, and adversely affect a larger segment of our population. There are no sections of the State, including the region along the seacoast, where fresh water mosquitoes do not occur. Control activities in places where salt marsh mosquitoes predominate are not satisfactory unless the operations include measures to control fresh water species as well.

This commission believes that any appropriations for salt marsh mosquito control, either local, State, or Federal, should be available for use against other species when a public health problem, either actual or potential, is found to exist, and when their abundance is great enough to cause a major annoyance.

MOSQUITO-BORNE DISEASES

While thirteen communicable human diseases are transmitted by mosquitoes, we are fortunate in North Carolina in that yellow fever, malaria, and encephalitis are the only ones that have ever become public health problems.

Yellow fever is well under control and has been eradicated in most of the world, including the United States. With rapid transportation facilities, it is still necessary, however, to maintain eternal vigilance to prevent its re-establishment. Several foci of the disease exist in South America, Africa, and Central America where it is endemic among certain species of monkeys, with an occasional human case. Two Brazilian states had 92 verified cases in 1953, with 82 deaths. In October of 1955, a post-mortem diagnosis of yellow fever was made in a zoo monkey by a veterinary pathologist in Florida.

Although malaria and encephalitis are the only communicable mosquito-borne diseases against which current control measures must be applied, it is true that secondary infections resulting from mosquito bites and the mental anguish experienced by some people can well be regarded as problems of public health significance. The Salt Marsh Mosquito Study Commission and the North Carolina State Board of Health concur in the following statement that was made by the Surgeon General of the United States Public Health Service and endorsed by other state health departments: "Public Health has become something more than the absence of disease. Physical efficiency and comfort, on which mental equanimity depends to a substantial degree, may be seriously disturbed by the continued annoyance of pestiferous mosquitoes which may or may not have disease-transmitting potentialities."

Malaria

There is only one known natural method by which malaria can be transmitted from one person to another -- through the bite of an anopheline mosquito. In North Carolina only one species, the Anopheles quadrimaculatus, can carry this disease. As the malaria mosquito is not able to pass the infection from mother to offspring, the only method by which she can become infected is by taking a blood meal from a person infected with the disease. If a community is free of malaria, the mosquitoes will not become infected, but if an infected person should move into the community or merely stay overnight and is bitten by a malaria mosquito, this mosquito becomes a potential spreader of the disease and may infect several other persons, who in turn will infect other mosquitoes. Eventually, the entire community may become infected.

For generations, after North Carolina was colonized, most of the population depended entirely upon the pursuit of agriculture. Transportation facilities were poor, making it necessary that practically all acticles of food or clothing be produced locally. Almost every community had a water mill that ground the wheat and corn raised by the sur-

rounding farmers. The ponds furnishing the power for these mills were ideal places for the propagation of malaria mosquitoes, causing malaria to be prevalent throughout the Piedmont, as well as in the eastern section of the State. Industrialization and improvement in transportation resulted in the abandonment of most of these mills. The dams gradually washed out and the number of ponds became smaller and smaller. A recession in malaria followed in the Piedmont area. In recent years, the high incidence of the disease has been confined almost entirely to the eastern part of the State where numerous natural breeding places for malaria mosquitoes existed.

In Table No. 5, the deaths reported clearly illustrate that an astounding diminution has taken place in the incidence of malaria in North Carolina. It will be seen that the reported deaths from the disease gradually fell from 150 in 1936 to 0 in 1948. For the first time in the history of vital statistics, a whole year elapsed without a single death from malaria being reported. The cases reported do not draw as clear a picture of the decline; neither are they as accurate.

Malaria was not made a reportable disease until 1937, and after that few physicians bothered to report it. Many patients relied on self-medication, and their cases were never recorded in morbidity statistics.

The blood slide results shown in the table were obtained from slides taken by the North Carolina State Board of Health on routine surveys among school children through the first six grades in counties regarded as being malarious.

Malaria control measures discussed elsewhere in this report can, to a large extent, be credited with the decline of this disease in North Carolina. We cannot, however, justify a relaxation in our efforts as long as any malaria remains in this State, or elsewhere in the world.

Infectious Encephalitis

Several types of encephalitis are of increasing public health importance, due to their seriousness and the fact that they are spreading to many areas in which they have not formerly occurred.

Because of an extremely complex transmission cycle, much remains unknown regarding this disease. Numerous species of birds, wild animals, domestic fowls, mosquitoes, mites, ticks, and other arthropods, as well as horses and human beings, are involved. The causative organism being a virus, and too small to study under a microscope, reduces the possibility of acquiring detailed knowledge concerning its development and spread. Available information indicates that birds, including domestic fowls and several species of mosquitoes, are the principal reservoirs and transmission agents. Man and equine animals appear to be only accidental hosts. When an epidemic of this disease occurs, horses almost invariably are affected first, with human cases developing later.

TABLE NO. 5
SHOWING DECLINE IN MALARIA
IN NORTH CAROLINA

Year	Cases Reported	Deaths Reported	Blood Slide Survey Results		
			Slides Taken	Slides Positive	Slides Positive per 1,000 Examined
1936	Not reportable	150	No survey		
1937	876	87	9,817	349	35.5
1938	636	70	12,937	105	8.1
1939	629	51	19,199	265	13.9
1940	629	61	8,479	15	1.8
1941	237	29	8,835	50	5.7
1942	248	33	23,226	15	0.6
1943	183	22	10,877	10	0.9
1944	151	25	No survey		
1945	552	24	18,436	10	0.5
1946	368	9	13,390	0	0.0
1947	137	2	5,769	0	0.0
1948	147	0	2,203	0	0.0
1949	53	2	3,670	0	0.0
1950	36	1	1,468	0	0.0
1951	82	3	No survey		
1952	305	3	No survey		
1953	48	0	No survey		
1954	38	0	No survey		
1955	18	2	No survey		

Encephalitis has occurred in numerous parts of the United States. One of the worst outbreaks on record took place in California in 1952, in which there were 753 human cases, with 51 deaths. Unfortunately, a large per cent of those who survive suffer life-long handicaps.

In 1955, with the excessive production of mosquitoes following the heavy rains that accompanied hurricanes Connie, Dianne, and Ione, an outbreak of encephalitis in horses occurred in twenty eastern North Carolina counties. By December, 171 cases, with an estimated mortality of 90%, had been reported to the North Carolina Department of Agriculture. Because of the following factors, it is conservatively estimated that at least 500 horses or mules died of the disease:

1. 1955 was the first year that a reporting system had been used.
2. There are no practicing veterinarians in 13 of the coastal counties.
3. Only 43% of the practicing veterinarians participated in the voluntary reporting system.

4. Of the 171 reported cases, ten veterinarians reported 130 from the following five counties:

Columbus	25
Pender	9
Bladen	23
Duplin	48
Lenoir	25

The monthly occurrence of reported equine cases follows:

July	None
August	5
September	49
October	99
November	11
December	5

During the 1955 outbreak, as many as 50% of the domestic pheasants in Cumberland and Robeson counties are believed to have died of encephalitis.

The following gives the human cases of infectious encephalitis and deaths from this disease that were reported to the North Carolina State Board of Health in recent years. Many of these resulted from infections not caused by mosquitoes.

Year	Cases	Deaths
1951	9	9
1952	4	5
1953	15	9
1954	47	8
1955	16	7

It will be noted, when these data are compared with those involving the 1952 epidemic in California, that the eastern strain is far more fatal than the western. For a long time this has been accepted as a fact by epidemiologists.

Culex quinquefasciatus and Mansonia perturbans, two species of mosquitoes that abound in Eastern North Carolina, have been found infected with the encephalitis virus in nature. Aedes Sollicitans and Aedes taeniorhynchus, our most annoying salt marsh mosquitoes, as well as several fresh water species found in this State, have been shown to be capable of transmitting the disease by laboratory experiments.

Efforts have been made by this Commission, in co-operation with the North Carolina State Board of Health, the Medical School of the University of North Carolina, and the United States Public Health Service, to gather and evaluate data that would increase existing knowledge of mosquito-borne encephalitis. One lot of Culex quinquefasciatus mos-

quitoes, that were captured on the same premises with an infected horse, was found to contain the virus of the western strain of this disease. This is the second time that this strain has been found on the Eastern Seaboard.

In 1956 the State Board of Health arranged with veterinarians to keep certain equine animals under observation in endemic areas. Blood samples were taken periodically, in an effort to detect current infections at the earliest possible date. When cases developed, mosquitoes would be taken on the premises and put on cold storage for later examination, in an attempt to isolate the virus. Complete data from these tests are not yet available.

This Commission, now that malaria is under control, regards encephalitis as the principal threat to public health and economy among the mosquito-borne diseases, and strongly recommends that increasing efforts be made to obtain fuller knowledge concerning its etiology, along with the development of effective control techniques. It is also our recommendation that provisions be made whereby present information can be continuously utilized to the fullest extent.

ADVERSE EFFECTS OF MOSQUITOES ON COMFORT, ECONOMY, AND GENERAL WELFARE

In response to letters to 26 persons in Eastern North Carolina known to be in charge of, or particularly interested in, mosquito control, requesting reports on adverse effects of mosquitoes on comfort, economy, and general welfare, the following information was received.

Currituck County - - Currituck County and the surrounding areas have experienced in the last year an abnormally large number of mosquitoes. A serious problem has always existed here with respect to the effects of normally great amounts of mosquitoes, but the problem has been critical during 1956. The economic benefit to this entire area would be tremendous if the mosquito problem could be solved.

The presence of so many mosquitoes in this area can truthfully be said to hamper seriously the raising of livestock by farmers of this area in that the freedom of the animals from this menace naturally would produce greater growth and healthier condition, and greater profits would accrue to the owners thereof. In addition, there were extended periods of time during 1956 when it was necessary for farmers to dress in heavy clothing in hot weather in order to work in the fields without being made completely miserable by the presence of swarms of mosquitoes. This condition naturally has had some adverse effect on the productive capacity of the farmers themselves.

Currituck County and the surrounding areas have a vast commercial and sport fishing program, upon which many of the citizens depend for a living. The mosquito problem here has caused many of the sport fishermen to go to other areas and has thereby severely reduced the income of the people dependent upon this activity. In recent years, many retired people from other areas have come here to establish their homes. Many of this type people, who have visited Currituck County with the idea of residing therein, have changed their plans and gone elsewhere because they did not wish to cope with the problem of fighting mosquitoes.

Currituck County is currently conducting a small scale mosquito control program. The results thereof are only partly satisfactory. The people here know that an effective mosquito control program cannot be established until the area is organized under a mosquito control district and the problem of fighting mosquitoes is undertaken scientifically and thoroughly.

Most of the people of this area are whole-heartedly behind the program of the Salt Marsh Mosquito Study Commission. They look upon this program as a hope for a brighter future. It is believed that the Commission is seriously hampered by inadequate funds for operation and should be provided with increased funds to accomplish its program.

Health District comprising Pasquotank, Perquimans, Camden, and Chowan Counties - - Economic losses in Pasquotank County, in which there

is no mosquito control program except within the corporate limits of Elizabeth City, are estimated to amount to $180,000. Benefits from Elizabeth City's mosquito control activities are estimated to be $100,000.

Economic losses in Perquimans County, in which there is no mosquito control program except within the corporate limits of the City of Hertford, are estimated to amount to $210,000. Benefits from Hertford's mosquito control program are estimated to be $15,000.

Benefits from the mosquito control program in Chowan County excluding the Town of Edenton, which started in midsummer of 1955 and continued until September 1956, are estimated to amount to $500,000. The County was allocated approximately $36,000 in July 1955, and drainage work continued until September 1956. The people of Chowan County have very highly endorsed this program and hope to see it continued.

The health of the people of the Town of Edenton has been greatly benefited through the mosquito control program. It is known that, with the additional water resulting from the hurricanes in 1955, the number of mosquitoes in this area increased considerably. This increase was noticed in the fall of 1955 and again early in the spring of 1956. Without the funds that were provided for use by the Town of Edenton, the mosquitoes would have increased to the point that they would have been a hazard to the health of the citizens. With the use of the mosquito control measures, there were very few mosquitoes in the community during the summer and fall of 1956. It is estimated that the Town of Edenton benefited in the amount of $20,000 in health so far as medicine, drugs, and work absenteeism are concerned. The Town sincerely appreciates the appropriation made available to it and hopes that this program will be continued in the future.

Camden County, in 1956, first participated in mosquito control performed with funds allocated by the Commission. A fog machine has been in operation, with good results being achieved. Officials of this county and the Health District Sanitarian, however, feel that the program is not adequate, as there is a great need for dragline work and ditching. The conclusion has been reached that, even with the 1956 spraying program, economic losses in Camden County have amounted to approximately $45,000. It is believed that this figure will cover economic losses, in all phrases thereof, which result from inadequate control. The Board of County Commissioners feel certain that the economic benefit from such a program will be sufficient to justify the expansion of the program. However, the county revenue is small; and expansion is going to depend, to a large extent, on the help which the county can get from outside funds that may be provided for that purpose. The Board certainly hopes that the Commission will find it possible to increase the budget for the coming years and assures the Commission that the Board will cooperate to the fullest extent possible under the circumstances.

Dare County - - Economically, Dare County progressed as a resort area by leaps and bounds immediately after the last war and the promise

appeared evident that this particular coast would soon become a travel and vacation mecca second to none in North Carolina and perhaps in much of the country. But this advance was at a time when the mosquito was not a menace. Now it is quite evident that the mosquito can and will retard this development and may hinder advancement to the point of disaster.

Property values have not suffered from the mosquito to any great extent because such values were bolstered by the attempts being made in the county to afford relief, but property sales became appreciably slowed by this menace. Dare County suffered most from cancellations of reservations in our hotels and other tourist facilities and from people who shortened their stay. The loss in dollar volume may be measured in the hundreds of thousands of dollars over two summers and, if not controlled, will amount to the loss of this source of income entirely. We cannot and will not ignore this situation and we must find a way to accomplish control.

It is advanced that the study now being conducted by the Salt Marsh Mosquito Study Commission into the life and habits of this pest is to be encouraged by all. This group should preserve its findings as a standard of procedure and its services expanded by employing more entomologists to assist local groups or districts. The Commission should publish a periodic directive so that information could be brought to the attention of the groups or districts affected. It is certainly advocated that adequate funds be provided by the legislature to continue the Salt Marsh Mosquito Study Commission and to expand its services.

City of Jacksonville - - The City greatly appreciates the mosquito control program and the benefits that have been received by it. The City believes that a degree of success with its mosquito control program has been had during 1956 that would not have been possible without the Commission's program. Those engaged in public administration in this area have received many complaints from citizens whose children suffer acutely from mosquitoes, sometimes involving illness and medical attention. The City Manager believes that he has not received a single complaint of this kind during 1956 and is certain that the Commission's program is due a great deal of credit for this accomplishment. It is impossible to stress too highly the importance of this particular benefit to the people of the City of Jacksonville.

The City's close proximity to the U. S. Marine Corps Base at Camp Lejune makes it a logical recreation center, during their off-duty hours, for the young men stationed there. This situation has resulted in an important recreation business in the area, including all types of outdoor recreation facilities -- such as golf range, archery, bowling, outdoor theaters, athletic events, automobile racing, and many others. During the height of the mosquito season, if the mosquitoes are not adequately controlled, there is considerable reduction in the attendance at these enterprises, thereby resulting in a serious economic loss to the community. The City Manager has been reliably informed that, during the height of the mosquito season, attendance is reduced as much as 50 per cent. One outdoor-theater manager informed him that, on many occasions, the theater manager had to refund a considerable amount of money and on one evening

in 1955, he was forced to return over $250.00 because his patrons could not remain throughout the entertainment because of the mosquitoes. The theater manager informed the City Manager that this theater has made very few refunds since the mosquito control program has been under way.

There are various groups of people in the City of Jacksonville who are interested in the development of the New River area adjacent to the city for aquatic sports -- such as swimming, boating, and fishing. The City Manager believes that adequate control of salt marsh mosquitoes will boost the use of this natural resource that is so readily available to the City of Jacksonville and make it an important feature in the economy of the community.

Leaders of the community have recognized the importance of encouraging retired service personnel to make their homes in and around Jacksonville. The city government is stressing this feature and, during the past few years, many fine service families have retired in Jacksonville, thereby contributing both in community activity and economically to the area. While it is not claimed that mosquitoes are a deciding factor in a retiring serviceman's choice of where to settle, the city government believes that adequate control of the salt marsh mosquito can be considered among the other features in determining his choice.

The city government feels that control of the salt marsh mosquito is, and can be, an important factor in the growth of Eastern North Carolina and sincerely appreciates the interest that the state government has taken in this important program.

Carolina Beach - - The economic value of the very splendid control of salt marsh mosquitoes, enjoyed by the citizens of the Town of Carolina Beach and visitors thereto during the peak tourist months of 1956, is inestimable, particularly if such satisfactory results can be maintained through several seasons or long enough to establish that the town is relatively free of the pests.

Some comparison can be made between October 1956 and the several immediately preceding months. During the last few days of October and on November 1 particularly, more mosquitoes were seen than during the immediately preceding months. Presumably, this condition resulted from discontinuance of control practices by New Hanover County.

Because of the high incidence of mosquitoes on November 1, it would appear that control plans should include the entire warm weather season during which mosquitoes can breed, since lack of such inclusion can have a vast economic effect upon the sport fishing as well as the late season tourist business.

It is believed that eradication or extensive reduction of mosquitoes would do more to hasten the economic development of Eastern North Carolina than any other one thing.

Brunswick County - - Farmers, livestock men, fishermen, and resort

owners have incurred damages from mosquitoes in 1956, ranging from small to high. Most of the damage is caused near the coast. Most every one agrees that the damage in 1956 is about 40 per cent of the 1955 damage.

The resort business seems to suffer more than any other business. The personal loss of one resort owner was approximately $800 in 1955. Most of those interested in the mosquito control program believe that more spraying and better control methods along the coastal marshes would be the best way of combatting the mosquitoes.

Carteret County - - Farmers and their farm labor have had less trouble from mosquitoes in 1956 than in many a year. The number of tourists to visit this section in 1956 exceeded all records, and they were not driven out by mosquitoes. Both urban and suburban areas of this county mark the summer of 1956 as being a summer almost entirely free from the pests. There were, in the Sea Level section, a few days when vast swarms of Aedes sollicitans moved in, but they were gone again in a matter of hours. The above information is evidence of what even limited mosquito control has done for this section of the coast. Even those most pessimistic in 1954 are now boasting of the results which have been produced from the mosquito control program in 1955 and 1956.

Pamlico, Hyde, Craven, and Beaufort Counties - - It is the desire of the people in Pamlico, Craven, Beaufort, and Hyde Counties to have a mosquito control program that can be put on a permanent basis whereby the economy of these counties, that are affected by the salt marsh mosquito, can be on a basis equal to that of other Coastal Plain and Piedmont Counties.

The tourist industry is rapidly increasing in the coastal counties each year and in many cases it would have been much greater had it not been for the great hordes of mosquitoes that invade certain areas on the coast after weather conditions have been conducive to their breeding. There have been numerous cases when an individual or a real estate dealer has sold a lot on which to build a summer home. After the buyer came to this lot during the summer and saw the great number of mosquitoes, he demanded that the seller refund his purchase price. During the peak mosquito season, the loss to farmers is great due to the loss of weight in livestock. Some farmers have stated, "We cannot ask labor to dig potatoes when they have to have one hand continually swatting mosquitoes. A person certainly can't dig as many potatoes with one hand as he could with two. It is a pure mess." There are times when loggers have difficulty working in the mosquito areas.

It is the opinion of the citizens of the coastal region that for the area near the marshes ever to grow, a permanent control program will have to be initiated. Many of the counties have done much on a temporary basis and would do more if they were financially able. As shown by the financial data in Table No. 12, even if Pamlico and Hyde Counties were sold for the price of their tax valuations, they would not bring enough to provide funds for performing the necessary drainage that would destroy all mosquito breeding places in these counties.

HISTORY OF MOSQUITO CONTROL IN NORTH CAROLINA

Historically, mosquito control in North Carolina, with few exceptions, has been motivated by the existence of malaria. The location of control activities has been influenced by the incidence of this disease, population densities, and economic factors.

North Carolina differs from most coastal states in that, at the time of early settlement, conditions along the seaboard were not favorable for the maintenance of large populations. As a result, most of the settlers moved inland and established towns and plantations; consequently, annoyance caused by Aedes sollicitans and other salt marsh mosquitoes was, until a relatively short time ago, limited to a small part of the population.

From the time our first permanent settlers came in from Virginia until a few years ago, malaria problems in varying degrees of severity existed in most parts of North Carolina. Even in the mountains occasional outbreaks occurred in the vicinity of impounded waters or abandoned gravel pits. Spasmodic control measures have been employed since 1913 when the first organized program in the United States was started at Roanoke Rapids.

During World War I, the Army conducted mosquito control activities in and around military establishments. Those operations were directed exclusively at the malaria mosquito, Anopheles quadrimaculatus. Following this war, for several years the U. S. Public Health Service participated in co-operative malaria control activities in several North Carolina towns.

Expansion in hydroelectric developments resulted in the inauguration of mosquito control on impounded waters. Private power companies and federal producers of electricity perform extensive anti-mosquito work on their reservoirs. Principal participants are The Carolina Power and Light Company, Duke Power Company, Virginia Electric and Power Company, Tennessee Valley Authority, and the U. S. Corps of Engineers. From 1952 through 1955, the latter has spent amounts ranging from $65,000 to $115,000 per year on their Kerr Lake to prevent mosquito breeding.

In 1937, the North Carolina State Board of Health adopted a regulation governing the impoundment and maintenance of impounded waters. This regulation, that is administrated co-operatively by the State Board of Health and local health departments, requires that the owner obtain a permit before building a pond with more than one-fourth acre of water surface. Embodied in the application for a permit is an agreement to maintain the pond in such a manner that it will not breed mosquitoes and become a nuisance dangerous to public health. Periodic inspections are made to assure compliance with the requirements. Exclusive of the major hydroelectric developments, there are over eight thousdand ponds under surveillance with a combined area in excess of 40,000 acres. Were this regulation not in existence, and the type of pond construction and maintenance that was followed prior to its adoption still practiced, it is believed that mosquito control would be a problem throughout the Piedmont section of North Carolina commensurate with its magnitude in eastern counties.

Prior to the beginning of the Work Relief Program, begun during the depression of the thirties, numerous large and small bodies of water were to be found almost anywhere in the eastern part of the State. Many of these were prolific breeders of malaria mosquitoes. In 1933, the Civil Works Administration furnished manpower to drain such places that were considered hazards to the public health. This drainage was sponsored and supervised by the North Carolina State Board of Health. The Emergency Relief Administration and The Work Project Administration, which were subsequent relief agencies, continued to provide personnel for malaria control drainage. This activity continued until the beginning of World War II.

Throughout this period, an average of 1,959 men worked each month on malaria control drainage; 2,956 miles of hand ditches and 372 miles of machine canals were dug to drain 98,606 acres of water surface. An additional 72 acres of ponds were eliminated by filling.

With funds provided by the United States Public Health Service during World War II, an extensive drainage and larviciding program for the control of malaria mosquitoes was conducted by the North Carolina State Board of Health around military establishments, principal liberty points for troops, and industrial centers having military significance. On this program 369 miles of hand ditches were cut, 6.1 miles of canals excavated by heavy machinery, and 20.7 miles of ditches blasted with dynamite. To prevent breeding of malaria mosquitoes, 221,555 gallons of fuel oil were applied as larvicides.

The discovery of DDT provided another method for combatting malaria. By applying this material as a residual spray to the walls and ceilings in homes where malaria was a community problem, a link in the transmission cycle could be broken. After becoming engorged with blood, the female mosquito would rest on a sprayed surface before flying off and be killed by the DDT. The number of homes sprayed each year is shown below:

Year	Premises Sprayed	Year	Premises Sprayed
1945	4,603	1950	40,992
1946	40,683	1951	41,870
1947	58,091	1952	38,207
1948	81,669	1953	36,541
1949	72,721		

The reduction in malaria shown elsewhere in this report is generally considered to be the result of these control measures, together with better medical care of the population and improved economic conditions.

In more recent years, with the incidence of malaria reduced almost to the point of eradication, control operations have been extended to include activities directed at other insects that adversely affect public health and the general welfare. As a result of this shift in emphasis from the malaria mosquito, much work is being done by local communities to control other species of these insects including those that breed in salt marshes.

STANDARD METHODS OF SALT MARSH MOSQUITO CONTROL

Salt marsh mosquito control operations are divided into three major categories. These divisions are also applicable to measures directed at any type of mosquito.

The most effective, and in practically all cases the most expensive, are permanent improvements, designed to so alter the environment as to destroy places in which mosquitoes breed or to render such places unfit for mosquito propagation. Included therein are ditching, filling, and dyking, as well as the destruction of containers in which some species breed.

The application of larvicides to kill mosquitoes in their immature stages is a widely practiced method.

Adulticiding, the third and least effective method of mosquito control, includes any measures directed at them in the adult stage. Included in this method are residual spraying and space spraying.

In rare instances, satisfactory control is obtained with natural enemies such as fish or predaceous insects.

Ditching, Filling, and Dyking

Before starting construction work, it is imperative that detailed entomological and engineering studies be made of the areas involved otherwise much expensive work that has no value would be performed. The entomological study would clearly define the specific places in which salt marsh mosquito eggs, larvae, and pupae are found. It would also show whether or not mosquitoes that breed in these places are likely to molest the population that the control measures are designed to protect. The engineering study would determine whether drainage, dyking, filling, or a combination of these measures would be the most practical from both economy and effectiveness, and present a plan whereby the chosen methods could be accomplished with the minimum removal of earth.

Operations in another southern state show that a dredge, suitable for moving earth in salt marshes, with supplementary facilities costs over $75,000. Earth is moved with this dredge at an average cost of eleven cents a cubic yard and at the rate of 181 cubic yards per hour.

Drainage work in the same state, with draglines of $\frac{1}{2}$ cubic yard capacity and costing around $15,000 each, is performed at from six to ten cents per cubic yard while hand ditching shows an average cost of about seventy cents per cubic yard.

As it requires 1613 cubic yards of earth to fill one acre to a depth of one foot, it can be readily seen that filling is in most cases impractical unless the material is obtained as a product of another activity.

The utilization of spoil from adjacent dredging operations to fill in low areas should always be done. Combined dredging and filling in places proved to be breeding salt marsh mosquitoes, especially along the periphery of the swamp is a practical and effective method. Initial costs are high but very little maintenance is necessary.

Outlet canals are located so as to pass through or as near as possible to established breeding places in order to reduce the need for lateral ditches, when this can be done without adversely effecting the alignment. As both construction and maintenance costs are high, drainage systems are designed with the minimum length of canals and minor ditches that will permit water to drain quickly from breeding places when high water elevations subside.

Dykes are constructed to prevent the entry of water into breeding places, and, in some instances, to hold water on them. In the first case, pumping in conjunction with the dyking is necessary to prevent flooding by rainwater and seepage. Dykes constructed to retain water inhibit the breeding of those species of mosquitoes that do not lay their eggs directly on water. The Aedes sollicitans and Aedes taeniorhynchus, our most troublesome salt marsh mosquitoes, are included in this group. In many salt marshes, instability of filling material or porosity of the soil makes dyking impractical. Maintenance costs on dyking are potentially high as they are subject to erosion by tides and destruction by hurricanes.

Larviciding

Petroleum oils and other chemicals are used to kill mosquito larvae. As it is estimated that mosquitoes breed in only 5% of the salt marsh areas, careful and complete entomological studies are necessary to ascertain the exact location of breeding before this type of control is inaugurated, in order to avoid a 95% waste in cost and effort.

Petroleum derivatives, such as No. 2 fuel oil, when used alone are very effective larvicides. As this requires about twenty gallons per acre, the current tendency is to add one of the newer chemical insecticides, in the chlorinated hydrocarbon or organic phosphate group, thus reducing the requirement to as little as one quart per acre, when correctly applied. As mosquitoes in some places are developing a resistance to DDT and other chlorinated hydrocarbons, this Commission has gone on record as opposing the use of chemicals in that group as larvicides. We strongly recommend that malathion or one of the other organic phosphates be employed. Regardless of the insecticide used, extreme caution should be exercised at all times to avoid the application at rates harmful to fish or other valuable wildlife.

Larvicides are dispersed from aircraft, boats, and ground equipment.

Adulticiding

The killing of adult mosquitoes is accomplished by several methods, those in most common use being residual spraying and space spraying.

In residual spraying, chemical insecticides are applied on surfaces where mosquitoes are expected to rest. DDT, the chemical most widely used for this type of control, when applied at a rate that leaves a residue of 200 mg. per square foot kills mosquitoes for months after the application is made.

Outdoor space spraying is performed by dispersing insecticides in the form of fogs or mist. Several machines, designed for this purpose, are commercially available. This type of control merely kills or drives off the insects present and gives no significant lasting effect when chemicals are applied at the recommended rates. Kills are seldom obtained at distances greater than 200 feet, but the fog, which travels much farther, has some value in driving mosquitoes out of the protected area.

Killing adult mosquitoes is the least satisfactory method and should be relied on only when resources are not available for drainage and larviciding or when these two methods are not effectively carried out. This is the cheapest method whereby a fair degree of temporary protection can be obtained against high densities of mosquitoes in communities with extensive breeding places.

MOSQUITO CONTROL BY MILITARY ESTABLISHMENTS IN NORTH CAROLINA

During World War II, The Federal Government felt justified in controlling mosquitoes in vast areas around military installations in addition to such work performed on government property. At the close of hostilities, with the reduction of funds and personnel, the areas of control were reduced. The consequent increase in the mosquito populations, in the once protected areas, stimulated civic groups to make numerous requests for assistance from the established military bases.

It became necessary, because of the numerous requests for assistance, for the Navy to establish a policy that would cover all mosquito control performed outside of naval installations. This policy as set forth in naval regulations is as follows:

"SECNAV INSTRUCTION 6250.1

From: Secretary of the Navy
To: All Shore Stations

Subj: Pest control in civilian communities; policy concerning naval assistance

"1. Purpose. This instruction sets forth the Navy's policy for providing assistance in pest-control problems in civilian communities.

"2. Cancellation. This instruction supersedes and cancels SECNAV Letter of 2 December 1948, NDB Cum. Ed. 1948, 48-924, p.110.

"3. Requests for Assistance. The Department of the Navy often receives requests from civilian communities and organizations for application of insecticides by aircraft and ground equipment and for other insect- and pest-control operations considered too large for local efforts. These requests originate most frequently in communities in the vicinity of naval establishments and are often made to local commanding officers.

"4. Policy. The following statement of policy is issued for guidance of all concerned in the handling of such requests:

a. Application of insecticides and rodenticides, whether by aircraft or ground equipment, on other than naval property is primarily a responsibility of the individual, group, governmental or other civil agency owning or controlling the property. Advice and assistance in dealing with insect and rodent problems can be obtained from local and State health departments, the United States Public Health Service, the State entomologist and local representatives of the United States Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, and the Fish and Wildlife Service

of the United States Department of the Interior.

b. Prior approval of the Secretary of the Navy is required for the expenditure of funds and the use of supplies, equipment, or personnel for the control of pests for the benefit of individuals, communities, States, or Federal agencies, except in an emergency. In an emergency, such action as is required will be taken by the local commander. In general, it is considered an improper use of Navy funds to conduct control operations that embody competition by the Navy with civilian firms engaged in pest-control activities. Except in emergencies, the Navy may assist in meeting local insect- and rodent-control problems only upon request of the United States Public Health Service, the United States Department of Agriculture, or the United States Department of the Interior. Funds shall be provided by the local management activity assuming cognizance and responsibility in the control of pests. The activity requesting the Secretary of the Navy for approval to assist local communities, or performing services in an emergency shall be responsible for providing necessary funds, material and personnel. In either case, agreement for reimbursement of the actual costs incurred shall be made by the naval activity and civilian authorities.

c. The limitations of paragraph 4.b. apply to local problem affecting primarily the civilian community. They do not restrict the initiative or remove the responsibility of local commanders in conducting pest-control measures over non-naval property necessary for preservation of health and morale of personnel of the Navy. Proper licenses, easements, permits, and/or clearances shall in all cases be obtained before taking action over privately or publicly owned lands to provide protection from claims against the Government as a result of the undertaking.

d. Where the naval installation and civilian community have a joint interest in an insect- and rodent-control problem, Navy participation in the control efforts shall be in proportion to its interest in the problem. This participation ordinarily will consist of the furnishing of equipment and personnel while the necessary supplies and ground services will be furnished by the civilian community. Control projects of joint interest shall be conducted in accordance with the provisions of paragraph 4.b.

C. S. THOMAS
Under Secretary of the Navy"

During the first season that the State of North Carolina established an abatement program and dispensed insecticides in territories adjacent to the military bases, a considerable decrease in adult mosquitoes was noted on the station. This may be construed to be the result of adulticiding with ground and aerial spraying by the surrounding counties.

It is evident that should the State and Counties continue an

agressive abatement program in areas adjoining military installations, the mosquito population would be reduced to a minimum, which would be of great value to the health, comfort and eceonomic welfare of military personnel.

MOSQUITO CONTROL IN OTHER STATES

Information from other states with salt marsh mosquito problems, that was provided in response to letters sent to officials in these states, shows in Table No. 6, that most of them are spending much more than North Carolina for the control of mosquitoes.

TABLE NO. 6
FUNDS PROVIDED FOR MOSQUITO CONTROL
IN OTHER STATES

State	State Appropriation	Local Funds	Total Funds
New Jersey	$ 60,000	$1,500,000	$1,560,000
Delaware	125,000	?	?
Maryland	213,690	?	?
Virginia	58,500	350,000	408,500
South Carolina	124,920	125,000	249,920
Georgia	-	?	?
Florida	1,734,329	1,664,361	3,398,690
Texas	?	382,557	?
California	400,000	3,500,000	3,900,000

In New Jersey, the state appropriation is used for aerial application of insecticides for the control of adult mosquitoes. Local appropriations of approximately $1,500,000 are provided by fifteen mosquito extermination districts. Additional funds not shown are appropriated by the State for research and inspection service. Information was provided by Dr. Bailey D. Pepper, Chairman, New Jersey Mosquito Control Study Commission.

In Delaware, the program is administered by the State Highway Commission. No reference to local expenditures was made in the reply received. Information was provided by Mr. Elwood Lynch, Mosquito Control Engineer.

In Maryland, the appropriation is new and did not become available until July 1, 1956. Mr. George S. Langford, Specialist in Insect Control, who provided the information, states that approximately sixty communities are co-operating, but as they are in process of getting organized, the amount of local funds is not known. The State will match on basis of 50% on adulticiding and larviciding, and 75% on permanent improvements.

In Virginia, the state contributes up to 25% of the amount provided locally by established mosquito control districts, but not to exceed $10,000.00 to any one district, provided state funds are adequate. Otherwise, the contribution is prorated in accordance with the amount available. This year funds permit only 70% of normal contribution, as

state appropriations have not kept pace with local expenditures. Information was provided by Mr. Rowland E. Dorer, Director, Bureau of Insect and Rodent Control, Virginia Department of Health.

In South Carolina, the state provides $84,000.00 for pesticides and other supplies that are donated to local projects, and $40,920.00 for salaries, travel, and other administrative expenses. Information was provided by Mr. Charles E. Corley, Chief of Sanitation, Division of Local Health Services, South Carolina State Board of Health. Local expenditures for 1956, as given above, are estimated by Mr. Corley.

In Georgia, no state funds are provided. Control is conducted with local funds around Savannah and Brunswick, as well as several other places.

In Florida, the state appropriates $1,734,329.00 for research, administration, and aid to districts and counties. The local appropriations include sanitary landfill operations. Information was provided by Mr. A. Patton, Secretary to Mr. John A. Mullrennan, Director, Bureau of Entomology, Florida State Board of Health.

In Texas, the state provides technical assistance and guidance but has no funds for actual control operations. The amount spent on this activity is not carried in a separate budget. Six counties have voted to create mosquito control districts with special tax levies. The counties provide $295,000.00 of the local expenditures, and the municipalities $87,556.85. Fifteen private industries spend amounts ranging from $1,000.00 to $5,000.00. Information was provided by Mr. F. J. Von Zuben, Jr., Chief, General Sanitation Services, Texas Department of Health.

In California, approximately thirty local agencies provide the $3,500,000.00 spent for mosquito control. In addition to the $400,000.00 used to subsidize local projects, the State provides consultation and advisory services, conducts research, and co-ordinates the reporting and records of mosquito densities. Information was provided by Mr. Richard F. Peters, Chief, Bureau of Vector Control, California Department of Health.

ENGINEERING SURVEY

A. Salt Marsh Survey

The engineering survey that has been made during the spring and summer of 1956 was primarily directed towards obtaining data as to the amount of potential breeding area for salt marsh mosquitoes. To facilitate this study, U. S. Geological Survey Maps were used with the potential areas being delineated on these maps in the field. The areas were then computed by the use of a polar planimeter.

As the survey progressed, it was deemed advisable to classify the potential breeding areas into three principal types as follows:

1. Salt Marsh Area. This area is comprised primarily of marsh that is flooded regularly by normal tide action. The principal vegetation is the needle rush and smooth cord grass. The mosquito breeding in these areas is limited to the perimeter of the marsh adjoining the mainland and to elevations within the marsh that are above normal tides, usually vegetated with salt water grasses.

2. Wooded Marsh Areas. These areas are comprised primarily of marsh that is above the normal tides and are flooded only intermittently by wind tides and storms. The primary vegetation is comprised of grass, shrubs, and some timber, all showing the effects of salt intrusion.

3. Salt Kill Areas. The salt kill area comprises areas of woodland, both pulpwood and timber, that has been killed due to salt deposited in the soil. The elevation is usually above normal tide and excessive wind tides.

The table shows the amount of salt marsh area by counties and types. An analysis of this data shows that of the total acreage of salt marsh, 75% of the marsh is located in the five counties of Carteret, Pamlico, Hyde, Tyrrell and Dare. These five counties also contain 95% of the salt kill area.

The topography of these counties is such that large areas are easily inundated by wind tides and storms that have frequented the area. The North Carolina Hurricane Project Report, prepared by Council of Defense, shows that these counties were almost completely flooded during the storms of 1955, large areas of which were covered with salt water. It is believed that the resultant salt intrusion has increased the potential breeding area for salt marsh mosquitoes by at least 75%.

As a result of the storms of 1954 and 1955, the effect of salt water intrusion has become a serious problem, especially in the low lying timber areas bordering the swamps and marshes along the coast. There has been sufficient salt deposited in these areas to kill brush and timber,

TABLE NO. 7
TOTAL AREA OF SALT MARSH, WOODED MARSH, AND SALT KILL IN NORTH CAROLINA

County	Salt Marsh Acres	Wooded Marsh Acres	Salt Kill Acres	Total Acres
1. Beaufort	10,694	7,392	2,611	20,697
2. Brunswick	22,029			22,029
3. Camden	890			890
4. Carteret	53,690	10,355	5,011	69,056
5. Craven	2,624	1,139		3,763
6. Currituck	19,130			19,130
7. Dare	43,840	36,275	31,904	112,019
8. Hyde	29,107	25,498	28,358	82,963
9. Onslow	10,650	954	2,176	13,780
10. Pamlico	21,248	3,859	12,755	37,862
11. New Hanover	13,645			13,645
12. Pasquotank		1,779		1,779
13. Pender	9,696			9,696
14. Tyrrell	435	8,870		9,305
Totals	237,678	96,121	82,815	416,614

and in many areas, salt water vegetation is replacing the former fresh water vegetation. The primary vegetation that has appeared in the salt kill areas has been Distichlis spicata grass that has a leaf system somewhat similar to Bermuda grass. From research conducted in other states, the presence of Distichlis spicata growth has been indicative of conditions suitable to the breeding of salt marsh mosquitoes.

The problem of drainage, which has always been a problem in the low lying areas, has been further aggravated by the storms and hurricanes. The drainage canals and streams have been blocked by debris and sand causing the impoundment of water in areas that had been fairly well drained. Excessive high tides flood these areas and upon receding leave ideal breeding areas for salt marsh mosquitoes. From past records, tides of two to four feet occur from three to five times during the year. During the present season, extremely high tides have occurred three times in connection with minor storm activity. After each of these, the adult mosquito populations have shown great increases. Proper drainage systems would allow the water to leave the marsh areas as the tides recede.

In the areas of timber salt kill, vast logging and pulpwood operations have been started. The common practice of ditching and using the spoil to provide roads into the area has been utilized rather extensively. In some cases, the spoil banks or roads have had insufficient culverts underneath to allow the removal of excess water impounded by the spoil bank. Such areas provide excellent areas for salt marsh mosquito breeding.

The area of salt kill concentrated at the entrance of the Intracoastal Waterway into the Alligator River, in Tyrrell County, requires special mention. This area has been a heavy producer of salt marsh mosquitoes throughout the past season. It is believed that the primary source of salt water that floods the area is probably coming through the Intracoastal Waterway into the low area surrounding the headwaters of the Alligator River. This assumption is made on the basis that the amount of salt kill above Frying Pan (Tyrrell County) is negligible, the topography of which is much the same as that around the head of the Alligator River. It must be recognized that this is an assumption that would require additional engineering data to substantiate.

In regard to the areas of salt kill, it is believed that these have an excellent opportunity of overcoming the effects of salt intrusion provided the area is not flooded with salt water by additional storms. There is some evidence that some of the areas are in the process of recovering, especially those above the flooding caused by wind tides.

The following statement was taken from the North Carolina Hurricane Project: "The Outer Banks, a major element in the state's recreational areas, have a primary function of providing protection to the mainland from the destructive forces of the open ocean, particularly where the Banks are close to the mainland. To the extent that the Outer Banks protect the mainland and draw thousands of tourists to the coastal areas, it is essential that they be built up and protected." The importance of the Outer Banks acquires greater significance when it is realized that they retard the effects of salt water in the rivers and bays along the coast. If it were not for the Outer Banks, the full force of the open ocean would extend the salt water up the rivers and create additional areas of potential breeding for salt marsh mosquitoes.

B. Estimated Cost of Permanent Control

In the determination of the cost of a permanent control program, it must be emphasized that the cost of ditching, filling, and dyking varies with the method employed, type of equipment used, efficiency of operation, soil types, and various topographical features. This makes it impossible to arrive at an actual figure that would show the cost of permanent mosquito control in any area, and especially so when consideration is given the different conditions to be found along the North Carolina coast. After careful study of available data obtained from other salt marsh mosquito control projects, it is estimated that on the average approximately twenty dollars per acre would be required to control salt marsh mosquitoes in North Carolina by a combination of the standard permanent control methods discussed elsewhere in this report, making a total estimated cost of $8,332,280.00. The range in variation from this estimate will probably be enormous.

It must be emphasized that in planning a permanent mosquito control program that the total expenditure will have to be allocated over a period of years. Before any permanent control program can be made operative,

there is considerable detailed planning that must be done. The total acreage figure that has been determined is the potential breeding area for salt marsh mosquitoes. However, it has been recognized that all of the actual salt marsh does not breed mosquitoes but a definite percentage has not been established. The total area of swamp marsh and salt kill would be considered breeding area. In order to plan an effective control program, detailed engineering and entomological studies will have to be made of the potential breeding areas. After such studies have been completed, detailed plans and recommendations can be made and a permanent control program initiated for that area. Due to many variable factors, the type of control program will vary for each area.

REPORT OF ENTOMOLOGICAL SURVEY

For the purpose of explanation and clarification, a brief introduction to the techniques utilized in the surveillance of mosquito population is given. The techniques described are used to give an index of the current mosquito population or as an estimation of future populations.

1. Sod Sampling - a cut of sod 1/12 foot square is taken in an area where mosquitoes have been known to be breeding. The sod is dried and then immersed in tap water. The water will hatch any mosquito eggs present in the sod. This is used to predict future populations.

2. Larval Dipping - use of a porcelain dipper in checking pools, puddles, or any type of standing water for presence of "wigglers" or larvae. This is used as an estimater of future populations.

3. Adult Biting Counts - the number of adult mosquitoes landing on a man's body surface in a 10 minute period are counted. This is an index of the current mosquito population. Authorities in the field consider a landing rate of one per man per minute (meaning over his entire body surface) an annoying infestation.

4. New Jersey Light Trap Counts - the New Jersey light trap is a device for collecting mosquitoes at night, serving as an indicator method for determining the mosquito population on a specific night and does not materially reduce the population. The trap consists of a light which serves to attract mosquitoes; then the mosquitoes are sucked downward by a rotating fan into a cyanide killing jar. New Jersey light traps have been placed at various points along the Eastern Seaboard of North Carolina and have been run two nights each week. Their catches of mosquitoes have been identified and tabulated in an effort to determine the population trends of mosquitoes on the Eastern Seaboard. These traps were placed when possible in areas which would not be fogged or sprayed.

The major portion of the data collected thus far has been obtained from adult biting records and light trap catches since the major objectives of the Commission have been to determine or locate mosquito breeding areas and determine the locations of population intensities of mosquitoes. Adult biting count data has been obtained by making periodic checks from Currituck County to Brunswick County. A sweep of the entire coastline was made at least once a month.

The data which follow are divided into three sections:

I Salt Marsh Mosquito Biting Counts
II Salt Marsh Mosquito Light Trap Catches
III Discussion of Entomological Data

Section I contains all the records of mosquito counts made from February to November of the year 1956, and some records from 1955. The sheets are divided into 4 columns. The first column contains the location of the station; the second, the day the count was made. The third column has the number of mosquitoes biting in a ten minute period and is sub-divided into three columns. The first of these sub columns lists Aedes sollicitans, the second, Aedes taeniorhynchus, and the third, other species. Aedes sollicitans and Aedes taeniorhynchus are the two predominant species of salt marsh mosquitoes and the ones against which control programs are directed. The fourth column contains total number of mosquitoes per count. The counts are listed alphabetically by county.

Section II contains all the records of light trap catches. The data sheets are divided into three major columns. The first gives the month and day that the trap was run, the second lists the three major species of mosquitoes caught in these traps, and the third column has the total number of mosquitoes caught in a single night in a trap.

Section III contains a discussion of the entomological data indicating some of the correlations between environmental factors and mosquito populations.

SECTION I
TABLE NO. 8
RECORDS OF MOSQUITO BITING COUNTS

Beaufort County

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	Total No. Mosquitoes
Belhaven, east of town	7-15-55	6	0	0	6
	3-27-56	4	0	0	4
	5-9-56	2	0	0	2
	5-30-56	25	0	0	25
	6-20-56	12	0	0	12
	7-20-56	5	0	0	5
	9-12-56	0	0	0	0
	10-11-56	3	0	0	3
	11-7-56	10	0	0	10
Aurora, near potato grader in woods	7-15-55	2	12	0	14
	9-12-56	0	0	0	0
	10-9-56	0	0	0	0
Pamlico Beach, the point	5-9-56	80	0	0	80
	5-30-56	115	0	0	115
	6-20-56	170	0	0	170
	7-26-56	50	0	0	50
	9-12-56	30	0	0	30
	10-3-56	75	0	0	75
	10-8-56	65	0	0	65
	11-7-56	250	0	0	250
Pamlico Beach, first house	5-9-56	90	0	0	90
	5-30-56	125	0	0	125
	6-20-56	130	0	0	130
	7-26-56	90	0	0	90
	9-12-56	20	0	0	20
	10-3-56	50	0	0	50
	10-8-56	170	0	0	170
	11-7-56	215	0	0	215
Moore's Beach	5-30-56	100	0	0	100
	6-20-56	80	0	0	80
	7-26-56	90	0	0	90
	9-12-56	0	0	0	0
	10-3-56	10	0	0	10
	10-8-56	5	0	0	5
	11-7-56	35	0	0	35

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Pungo Creek	5-30-56	10	0	0	10
	6-20-56	0	0	0	0
	9-12-56	0	0	0	0
Washington, bridge	5-31-56	0	0	7	7
Pantego Creek, outside Belhaven	6-20-56	12	0	0	12
	9-12-56	0	0	0	0
	10-3-56	5	0	0	5
	10-8-56	5	0	0	5
	11-7-56	0	0	0	0
Cuckold's Creek	9-12-56	0	0	0	0
Jack Creek	9-12-56	0	0	0	0
Bath	5-30-56	0	0	0	0
	10-8-56	0	0	0	0
	Brunswick County				
Wilmington, in woods across river	7-12-55	17	9	0	26
Wilmington, pulp yard across river	7-12-55	0	0	0	0
Orton Plantation, rice field in back of utility shed	3-14-56	1	0	0	1
	5-9-56	24	0	0	24
	9-6-56	150	0	0	150
	10-24-56	45	0	0	45
Orton Plantation, church ruins	9-6-56	600	0	0	600
	10-24-56	50	15	0	65
Orton Plantation, woods	9-6-56	10	250	0	260
	10-24-56	35	15	0	50
Holden's Beach	7-31-56	3	0	0	3
	9-4-56	0	0	0	0
	9-19-56	0	0	0	0
	10-24-56	1	0	0	1
Ft. Caswell Beach, marsh area	5-9-56	0	0	0	0
	7-31-56	1	0	0	1
	9-5-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Ft. Caswell Beach, marsh area	9-17-56	5	0	0	5
	10-24-56	30	0	0	30
Ft. Caswell, woods	5-9-56	0	0	0	0
	7-31-56	1	0	0	1
	9-5-56	0	0	0	0
	9-17-56	5	0	0	5
	10-24-56	35	0	0	35
Long Beach, swamp	7-31-56	1	0	0	1
	9-5-56	0	0	0	0
	10-24-56	45	0	0	45
Long Beach, side road of fish house	5-9-56	0	0	0	0
	7-31-56	1	0	0	1
	9-5-56	0	0	0	0
	10-24-56	30	0	0	30
Seaside	9-4-56	0	0	0	0
	10-25-56	0	0	0	0
Gause's Landing	6-5-56	0	0	0	0
	9-4-56	0	0	0	0
	10-25-56	45	0	0	45
Ocean Isle Ferry	6-5-56	0	0	0	0
	9-4-56	0	0	0	0
Sunny Point, swamp	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-31-56	0	0	0	0
	9-5-56	0	0	0	0
Southport	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-31-56	0	0	0	0
	9-5-56	0	0	0	0
Southport, west side of town	9-17-56	25	0	0	25
Southport, east side of town	9-17-56	5	0	0	5
	10-24-56	0	0	0	0
Road to Ft. Caswell	9-17-56	5	0	0	5

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollic-itans	Aedes taenio-rhynchus	Other Species	
Road from Holden's Beach to Shallotte	9-19-56	8	0	0	8
Shallotte	6-5-56	0	0	0	0
	7-31-56	0	0	0	0
	9-19-56	5	0	0	5
	10-25-56	0	0	0	0
Shallotte Point	6-5-56	0	0	0	0
	7-31-56	0	0	0	0
	9-4-56	0	0	0	0
	9-19-56	5	0	0	5
	Camden County				
Old Trap, outskirts of town on water's edge	7-24-56	10	0	0	10
	8-22-56	0	0	0	0
	9-20-56	0	0	0	0
Old Trap, woods on outskirts of town	7-24-56	16	0	0	16
	8-22-56	0	0	0	0
	9-20-56	0	0	0	0
Stop midway Old Trap and Shiloh	7-24-56	40	0	0	40
	8-22-56	0	0	4	4
	9-20-56	0	0	5	5
1 mile outside Shiloh	7-24-56	10	0	0	10
Outskirts of Elizabeth City	10-4-56	0	0	0	0
	Carteret County				
Morehead City, near Copeland Motor Court. West of City, in woods	7-13-55	0	10	0	10
	5-15-56	10	70	0	80
	5-30-56	0	5	0	5
	6-19-56	0	20	0	20
	8-8-56	0	80	0	80
	8-28-56	0	0	0	0
	10-1-56	5	0	0	5
Beaufort, woods at water's edge	7-13-55	0	0	0	0
	5-15-56	5	0	0	5
	6-19-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Beaufort, woods at water's edge	8-7-56	0	0	0	0
	10-1-56	0	0	0	0
Atlantic Beach, wooded area on sound side	7-13-55	6	0	0	6
	5-31-56	0	0	0	0
	8-9-56	0	0	0	0
	8-30-56	0	0	0	0
	10-1-56	0	0	0	0
Cedar Island, woods opposite Goodwin's Farm	5-15-56	65	0	0	65
	6-19-56	65	0	0	65
	8-7-56	200	10	0	210
	8-28-56	50	0	0	50
	10-1-56	90	0	0	90
Cedar Island, Goodwin's Fish House	5-15-56	30	50	0	80
	5-30-56	0	14	0	14
	6-19-56	0	40	0	40
	8-7-56	200	40	0	240
	8-28-56	35	0	0	35
	10-1-56	140	0	0	140
Road to Lola, opposite borrow pit	5-15-56	30	0	0	30
	6-19-56	85	0	0	85
	8-7-56	280	0	0	280
	8-28-56	40	0	0	40
	10-1-56	170	0	0	170
Lewis Creek	8-7-56	440	0	0	440
	8-28-56	105	0	0	105
	10-1-56	210	0	0	210
Borrow Pit, west of Sea Level Hospital	5-15-56	62	0	0	62
	5-30-56	47	0	0	47
	6-19-56	35	0	0	35
	8-7-56	40	0	0	40
	8-28-56	20	0	0	20
	10-1-56	50	0	0	50
East of Davis	5-15-56	15	0	0	15
	6-19-56	6	0	20	26
	8-7-56	45	10	0	55
	8-28-56	5	0	0	5
	10-1-56	55	0	0	55
Ft. Macon, woods	5-31-56	0	2	0	2

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Ft. Macon, woods	8-9-56	0	0	0	0
	8-30-56	0	0	0	0
Cedar Island, beach	8-7-56	170	0	0	170
	8-28-56	80	0	0	80
	10-1-56	125	0	0	125
Roe, edge of marsh	8-7-56	120	0	0	120
	8-28-56	170	0	0	170
	8-29-56	220	0	0	220
Thoroughfare bridge	8-7-56	85	0	0	85
Opposite Atlantic, field	8-7-56	210	0	0	210
Atlantic, outskirts of town	8-7-56	90	0	0	90
	8-28-56	0	0	0	0
	10-1-56	90	0	0	90
Harker's Island, Shell Point	8-7-56	30	0	0	30
Brooks Point, Harker's Island	8-7-56	10	0	0	10
Ward's Creek	8-7-56	3	0	0	3
North River	8-7-56	0	0	0	0
Back Creek	8-7-56	10	0	0	10
4 miles north of Beaufort	8-7-56	40	0	0	40
Emeral Isle	8-9-56	0	0	0	0
	8-30-56	0	0	0	0
Salter Path	8-9-56	0	0	0	0
	8-30-56	0	0	0	0
Stacy, edge of town	8-28-56	10	0	0	10
Salter's Grill on Route 70	8-28-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Smyrna, outskirts	8-28-56	0	0	0	0
	10-1-56	0	0	0	0
Mitchell Village	8-28-56	0	0	0	0
Bogue Country Club and Inlet	8-28-56	0	0	0	0
Newport, bridge	8-30-56	0	0	0	0
	10-1-56	0	0	0	0
Road between Sea Level and Atlantic	8-28-56	20	0	0	20
	10-1-56	90	0	0	90
Road between Cedar Island and Atlantic	10-1-56	135	0	0	135
1 mile east of Williston	10-1-56	30	0	0	30
		Chowan County			
Edenton, edge of town at wharves	5-28-56	0	0	0	0
	8-20-56	0	0	0	0
	9-17-56	0	0	0	0
Edenton, wooden bridge	8-20-56	0	0	0	0
	9-17-56	0	0	0	0
		Craven County			
New Bern, mule barn	5-31-56	0	0	5	5
New Bern, mule barn	5-31-56	0	0	23	23
Riverview Recreational Area	8-1-56	0	0	0	0
River Junction of Neuse and Trent, in woods	8-1-56	1	0	0	1
Woods further up	8-1-56	0	0	0	0
4 more areas in woods checked	8-1-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollic-itans	Aedes taenio-rhynchus	Other Species	
2 little settlements of about ½ doz. homes	8-1-56	0	0	0	0
Logging camp in woods	8-1-56	10	0	0	10 reported bad by loggers
		Currituck County			
Currituck, wooded area at water's edge	7-19-56	0	0	0	0
	7-25-56	60	0	0	60
	9-20-56	0	0	0	0
	11-6-56	0	0	0	0
Barco, wooded area ½ mi. south of junction of U.S. 158	7-19-56	0	0	1	1
Coinjock, woods near waterway	7-19-56	0	2	0	2
	8-24-56	0	0	6	6
	9-20-56	0	0	0	0
	10-4-56	0	30	0	30
	10-12-56	0	0	0	0
	11-6-56	10	10	0	20
Poplar Branch	7-19-55	0	0	0	0
	7-25-56	100	0	0	100
	8-24-56	5	0	0	5
	9-20-56	0	0	0	0
	10-4-56	5	0	0	5
Point Harbor	7-19-55	0	0	0	0
	6-14-56	5	0	0	5
	7-25-56	40	0	0	40
	10-4-56	5	0	0	5
Fligo	5-1-56	2	0	0	2
	7-25-56	10	0	0	10
	9-20-56	0	0	0	0
Waterlilly Marsh	5-1-56	3	0	0	3
	7-25-56	8	0	0	8
Maple	5-1-56	2	0	0	2
	7-25-56	15	0	0	15

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Maple	9-20-56	0	0	0	0
Grandy, market on outskirts	6-14-56	7	0	0	7
	7-25-56	30	20	0	50
Meals Creek, Poplar Branch	7-25-56	40	0	0	40
Poplar Branch Point	7-25-56	60	0	0	60
Woodland road behind Grandy, North River side	7-25-56	110	0	0	110
1 mile outside Grandy, U. S. 158	7-25-56	30	10	10	50
Powell's Point	7-25-56	35	0	0	35
Spot, woods past Post Office	8-24-56	0	0	0	0
Aydlett	8-24-56	5	0	0	5
	9-20-56	0	0	0	0
		Dare County			
Kitty Hawk, in woods	7-19-55	6	8	0	14
	2-28-56	0	0	0	0
	4-5-56	0	0	0	0
	10-4-56	60	0	0	60
	10-11-56	10	0	0	10
	11-6-56	10	0	0	10
Collington	7-19-55	2	1	5	8
	2-29-56	0	0	0	0
	4-5-56	0	0	0	0
Wanchese, garbage dump	7-19-55	23	21	0	44
	2-29-56	0	0	0	0
	4-5-56	50	0	0	50
	4-26-56	120	0	0	120
	5-29-56	85	0	0	85
	6-14-56	160	0	0	160
	8-22-56	105	0	0	105

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Wanchese, garbage dump	9-19-56	180	0	0	180
	10-3-56	20	0	0	20
	10-11-56	30	0	0	30
Lost Colony Park	7-19-55	21	14	0	35
	4-26-56	200	0	0	200
	5-29-56	0	0	0	0
	8-23-56	1	0	0	1
	9-19-56	4	0	0	4
Manteo, Ferry Landing	7-19-55	12	8	0	20
Oregon Inlet	7-19-55	64	0	0	64
	4-5-56	50	0	0	50
	5-2-56	150	0	0	150
	6-14-56	85	0	0	85
	9-18-56	40	0	0	40
	10-11-56	25	0	0	25
Mann's Harbor, Post Office	3-27-56	15	0	0	15
	5-2-56	60	0	0	60
	9-19-56	10	0	0	10
	10-11-56	20	0	0	20
	11-7-56	12	0	0	12
Stumpy Point, road bend	3-27-56	2	0	0	2
	5-2-56	500	0	0	500
	9-19-56	100	0	0	100
	10-11-56	85	0	0	85
	11-7-56	100	0	0	100
Across street from Midway Garage	4-5-56	55	0	0	55
Swamp adjacent to Midway Garage	4-5-56	70	0	0	70
Rabbit hutch behind Alfred's Cafe	4-5-56	27	0	12	39
Roadside ditch on Route 345 into Wanchese	4-5-56	6	0	2	8
	4-26-56	150	0	0	150
	8-22-56	55	0	0	55
	9-19-56	120	0	0	120
	10-11-56	20	0	0	20

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollic-ivans	Aedes taenio-rhynchus	Other Species	
Outskirts of Manteo	4-26-56	200	0	0	200
	6-14-56	65	0	0	65
	8-23-56	15	0	0	15
	9-19-56	5	0	2	7
	10-11-56	10	0	0	10
	11-6-56	6	0	0	6
Area opposite burnt marsh on Wanchese Road, in woods	4-26-56	90	0	0	90
	8-22-56	30	0	0	30
	9-19-56	250	0	0	250
	10-3-56	10	0	0	10
Brunsides Swamp	5-1-56	25	0	0	25
Old Ferry Landing, swamp	5-1-56	140	0	0	140
	9-18-56	40	0	0	40
5 miles north of Stumpy Point, along highway	5-2-56	150	0	0	150
	9-19-56	50	0	0	50
	10-11-56	25	0	0	25
	11-7-56	25	0	0	25
9 miles north of Stumpy Point, along highway	5-2-56	120	0	0	120
Swamp area at Whale-bone	2-28-56	0	0	0	0 eggs were found
	5-2-56	800	0	0	800
	5-29-56	155	0	0	155
	8-21-56	370	0	0	370
	9-19-56	240	0	0	240
	10-4-56	260	0	0	260
	10-11-56	0	0	0	0
	11-6-56	0	0	0	0
Cape Hatteras National Seashore Recreational Area, Lighthouse on Bodie Island	5-2-56	40	0	0	40
	5-30-56	105	0	0	105
	6-14-56	85	0	0	85
	8-22-56	170	0	0	170
	9-19-56	60	0	0	60
	10-11-56	30	0	0	30
Gray's Fish House in Wanchese	8-22-56	20	0	0	20
	9-19-56	5	0	0	5

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Gray's Fish House in Wanchese	10-3-56	10	0	0	10
	10-11-56	0	0	0	0
Woods near Gray's Pier	8-22-56	5	0	0	5
	9-19-56	90	0	0	90
	10-3-56	5	0	0	5
	10-11-56	20	0	0	20
Woods near wharves in Wanchese	8-22-56	25	0	0	25
Wanchese Cemetery	8-22-56	30	0	0	30
	9-19-56	45	0	0	45
	10-3-56	30	0	0	30
	10-11-56	55	0	0	55
Hatteras Flats	4-4-56	0	0	0	0
	9-18-56	0	0	0	0
Outskirts of Hatteras	4-4-56	0	0	0	0
	9-18-56	0	0	0	0
Woods outside Frisco	4-4-56	0	0	0	0
	9-18-56	0	0	0	0
Avon	4-4-56	0	0	0	0
	9-18-56	0	0	0	0
Marsh between Salvo and Waves	4-4-56	0	0	0	0
	9-18-56	20	0	0	20
Outside Rodanthe	9-18-56	10	0	0	10
Buxton School	4-4-56	0	0	0	0
	9-18-56	0	0	0	0
Ferry Landing on Hatteras Island	9-18-56	50	0	0	50
Bodie Island, 5 miles from Oregon Inlet, ocean side	9-18-56	60	0	0	60
Stumpy Point, boat landing	9-19-56	60	0	0	60

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
West Virginia Paper & Pulp Co., property between Stumpy Point and Mann's Harbor from sound to road at approximately 300 paces apart	9-19-56				
	A	120	0	0	120
	B	230	0	0	230
	C	370	0	0	370
	D	280	0	0	280
	E	100	0	0	100
	F	170	0	0	170
	G	210	0	0	210
	H	80	0	0	80
	I	120	0	0	120
Point past Lost Colony	9-19-56	15	0	0	15
	10-3-56	50	0	0	50
	10-11-56	10	0	0	10
	11-6-56	15	0	5	20
Road between Manteo and Lost Colony Park	9-19-56	5	0	0	5
	10-11-56	10	0	0	10
East Lake Ferry Road, fire tower	11-7-56	0	0	5	5
10 miles South of Stumpy Point	11-7-56	70	0	0	70
20 miles south of Stumpy Point	11-7-56	135	0	0	135
		Hyde County			
Outskirts of Engelhard, north	3-27-56	5	0	0	5
	6-20-56	50	0	0	50
	7-26-56	12	0	0	12
	9-12-56	90	0	0	90
	10-3-56	20	0	0	20
	10-11-56	55	0	0	55
	11-7-56	20	0	0	20
3 miles north of Engelhard	6-20-56	135	0	0	135
	7-26-56	40	0	0	40
	9-12-56	25	0	0	25

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollic-itans	Aedes taenio-rhynchus	Other Species	
7 miles north of Engelhard	6-20-56	72	0	0	72
	7-26-56	45	0	0	45
	9-12-56	20	0	0	20
	10-3-56	15	0	5	20
	10-11-56	40	0	0	40
14 miles north of Engelhard	9-12-56	40	0	0	40
	10-3-56	0	0	0	0
	10-11-56	115	0	0	115
	11-7-56	135	0	0	135
21 miles north of Engelhard	10-3-56	0	0	0	0
	10-11-56	60	0	0	60
3 miles south of Engelhard	6-20-56	15	0	0	15
14 miles south of Engelhard	6-20-56	4	0	0	4
	9-12-56	0	0	0	0
Town of Engelhard, by Cafe	6-20-56	18	0	0	18
	7-26-56	10	0	0	10
	9-12-56	0	0	0	0
	10-3-56	5	0	0	5
	10-10-56	0	0	0	0
	11-7-56	85	0	0	85
Swan Quarter, south east, near saw mill	3-27-56	36	0	0	36
	6-20-56	30	0	0	30
	7-26-56	200	0	0	200
	8-23-56	80	0	0	80
	9-12-56	0	0	0	0
	10-3-56	105	0	0	105
	10-10-56	50	0	0	50
	11-7-56	20	0	0	20
Swan Quarter, north outskirts	6-20-56	8	0	0	8
	7-26-56	60	0	0	60
Scranton Creek	6-20-56	15	0	0	15
	7-26-56	10	0	0	10
	9-12-56	10	0	0	10
	10-3-56	5	0	0	5
	11-7-56	10	0	0	10
Fairfield	7-26-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollic-itans	Aedes taenio-rhynchus	Other Species	
Fairfield	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Gulrock, abandoned field	7-26-56	1640	0	0	1640
	9-12-56	500	0	0	500
	10-10-56	265	0	0	265
	11-7-56	125	0	0	125
Ione O'Neal's home, Gulrock	7-26-56	200	0	0	200
Soybean field outside Swan Quarter	7-26-56	70	0	0	70
	8-23-56	250	0	0	250
	10-3-56	70	0	0	70
	10-10-56	115	0	0	115
	11-7-56	50	0	0	50
Ocracoke Island	8-12-56	5	0	0	5
Juniper Canal, head	8-23-56	120	0	0	120
Fire Tower, game refuge	8-23-56	250	0	0	250
New Holland	9-12-56	0	0	0	0
Rose Bay	10-3-56	0	0	0	0
		New Hanover County			
Wooded area near Greenfield Lake and Creosote Plant	7-12-55	0	5	0	5
Wooded area 1 mile south of Esso Terminal	7-12-55	3	1	0	4
	6-5-56	15	0	0	15
	7-30-56	9	0	0	9
Highway Park at Inland Waterway on Highway 421	7-12-55	1	8	0	9
Woods near Wilmington Landfill	7-12-55	0	6	0	6

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Woodland pond 1 mile in and west of Old Ft. Fisher gate	3-14-56	1	0	1	2
	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
Wrightsville Beach	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	0	0	0
	10-24-56	5	0	0	5
Kure Beach	3-14-56	0	0	0	0
	5-9-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	0	0	0
	10-24-56	10	0	0	10
Wilmington Beach	5-9-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	0	0	0
	10-24-56	15	0	0	15
Carolina Beach	3-14-56	0	0	0	0
	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	0	0	0
	10-24-56	5	0	0	5
Ft. Fisher, swamp area	3-14-56	0	0	0	0
	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	0	0	0
	10-24-56	35	0	0	35
Ft. Fisher, woods	3-14-56	0	0	0	0
	5-9-56	0	0	0	0
	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	10	30	0	40
	10-24-56	20	30	0	50
Wilmington, Sunset Park Area	5-9-56	0	0	0	0
	6-5-56	20	0	0	20
	7-30-56	3	0	0	3

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Wilmington, downtown	6-5-56	0	0	0	0
	7-30-56	0	0	0	0
	9-4-56	0	2	0	2
		Onslow County			
Swansboro	7-13-55	0	0	0	0
	5-30-56	0	0	0	0
	8-8-56	0	0	0	0
Snead's Ferry	4-10-56	0	0	0	0
	9-11-56	35	0	0	35
	9-24-56	120	0	0	120
Fulcher's Landing	4-10-56	0	0	0	0
	9-11-56	20	0	0	20
Thomas' Landing	4-10-56	0	0	0	0
	9-11-56	180	0	0	180
Hammock Beach	8-8-56	0	0	0	0
Petiford Creek, Oak River Road	8-8-56	0	0	0	0
Everett's Creek	9-10-56	10	15	0	25
2 miles from Everett's Creek	9-10-56	15	40	0	55
3 miles from Everett's Creek	9-10-56	45	10	0	55
Folkstone	9-11-56	60	0	0	60
	9-24-56	100	0	0	100
Turkey Creek	9-11-56	55	10	0	65
Road to Morris Landing	9-11-56	25	0	0	25
Morris Landing	9-11-56	30	0	0	30
King's Creek, upper end	9-11-56	130	0	0	130

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
King's Creek, lower	9-11-56	140	0	0	140
Junction of Sand Road and Road to Hollyridge	9-11-56	175	0	0	175
Hollyridge, outskirts	9-11-56	35	0	0	35
Hollyridge, outskirts, Surf City Road	9-11-56	110	0	0	110
Camp Davis	9-11-56	18	5	0	23
New River Inlet, Outer Banks	9-11-56	15	0	0	15
	10-23-56	45	0	0	45
1 mile from New River Inlet, Outer Banks	9-11-56	0	0	0	0
	10-23-56	70	0	0	70
2 miles south from New River Inlet, Outer Banks	9-11-56	0	0	0	0
	10-23-56	55	0	0	55
3 miles south from New River Inlet, Outer Banks	9-11-56	20	0	0	20
	10-23-56	230	0	0	230
4 miles south from New River Inlet, Outer Banks	9-11-56	0	0	0	0
	10-23-56	80	0	0	80
5 miles south from New River Inlet, Outer Banks	9-11-56	35	0	0	35
	10-23-56	205	0	0	205
6 miles south from New River Inlet, Outer Banks	9-11-56	45	0	0	45
	10-23-56	230	0	0	230
7 miles south from New River Inlet, Outer Banks	9-11-56	5	0	0	5
	10-23-56	220	0	0	220
8 miles south from New River Inlet, Outer Banks	9-11-56	10	0	0	10

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Seahaven Beach	9-11-56	35	0	0	35
	10-23-56	115	0	0	115
Ocean City Beach	9-11-56	45	0	0	45
	10-23-56	145	0	0	145
Onslow - Pender Co. line on Outer Banks	9-11-56	80	0	0	80
		Pamlico County			
Bayboro, near Old Health Dept.	7-15-55	1	14	0	15
Woods near Mesic	7-15-55	60	10	1	71
	10-2-56	15	0	0	15
	10-9-56	10	0	0	10
Hobucken, wooded area near garbage dump	7-15-55	78	32	0	110
	3-22-56	13	0	0	13
	8-2-56	240	0	0	240
	10-2-56	65	0	0	65
	10-9-56	85	0	0	85
Janeiro	8-2-56	4	0	0	4
	10-2-56	25	0	0	25
	10-9-56	60	0	0	60
Old House Creek	8-2-56	10	0	0	10
Gum Thicket Swamp	8-2-56	55	0	0	55
	8-30-56	100	0	0	100
Spice Creek	8-2-56	0	0	0	0
	8-30-56	850	0	0	850
Pamlico, outskirts of town	8-2-56	0	0	0	0
	8-30-56	200	0	0	200
	10-2-56	170	0	0	170
	10-9-56	35	0	0	35
Concord Church	8-2-56	3	0	0	3
Moore's Creek	8-2-56	2	0	0	2

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Dirt road into Pamlico from Oriental, midway	8-2-56	10	0	0	10
	10-2-56	35	0	0	35
	10-9-56	110	0	0	110
Fishing shack on dirt road to Pamlico	10-2-56	70	0	0	70
	10-9-56	120	0	0	120
Goose Creek	8-2-56	77	0	0	77
	10-2-56	0	0	0	0
	10-9-56	0	0	0	0
Lowlands	8-2-56	60	0	0	60
	10-3-56	15	0	0	15
1 mile southeast of Florence	8-30-56	150	0	0	150
Head of Richardson Creek	8-30-56	200	0	0	200
Head of Spring Creek	8-30-56	250	0	0	250
	10-9-56	140	0	0	140
1 mile south of Florence School, pasture land	8-30-56	125	0	0	125
Whartonville	8-30-56	125	0	0	125
Woodland pasture between Whartonville and Head of Brown Creek	8-30-56	50	0	0	50
Head of Pierce Creek	8-30-56	25	0	0	25
Kennel's Beach	10-2-56	0	0	0	0
Minnesott Beach	10-2-56	0	0	0	0
	10-9-56	0	0	0	0
Between Arapahoe and Oriental, 9 miles from Arapahoe	10-2-56	5	0	0	5
Oriental	10-2-56	0	0	0	0
	10-9-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Merritt, Trent Creek	10-2-56	0	0	0	0
	10-9-56	20	0	0	20
Vandemere, dump	10-2-56	20	0	0	20
	10-9-56	10	0	0	10
Vandemere, edge of town	10-2-56	10	0	0	10
	10-9-56	0	0	0	0
Sound View Beach	10-2-56	155	0	0	155
Florence	10-2-56	50	0	0	50
Bayboro	10-3-56				
A - East Side		5	0	0	5
B - West Side		5	0	0	5
C - North Side		5	0	0	5
D - South Side		0	0	0	0
Brown Creek	10-9-56	20	0	0	20
Upper Brown Creek	10-9-56	30	0	0	30
Branch of Bay River	10-9-56	50	0	0	50
Trent Creek	10-9-56	10	0	0	10
		Pasquotank County			
Sound Neck	9-20-56	0	0	0	0
Weeksville, swamp near school	9-20-56	0	0	0	0
		Pender County			
Land side of Inland Waterway at Surf City	7-13-55	9	7	0	16
New Topsail Beach, No. 2 tower	4-10-56	10	0	0	10
	5-17-56	105	0	1	106
	5-30-56	19	1	0	20
	8-8-56	4	0	0	4
	9-11-56	35	10	0	45
	10-23-56	110	0	0	110

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
½ mile southwest of dog house on Topsail Beach	5-17-56	7	52	0	59
	8-8-56	2	10	0	12
	9-11-56	15	0	0	15
	10-23-56	85	0	0	85
Surf City, south side outskirts	3-17-56	20	30	0	50
	8-8-56	0	0	0	0
	9-11-56	20	0	0	20
	10-23-56	185	0	0	185
Little Kinston, at marsh edge	4-10-56	20	0	4	24
	5-17-56	85	0	0	85
	5-30-56	9	0	0	9
	8-8-56	30	20	0	50
	9-11-56	230	0	0	230
	10-23-56	250	0	0	250
Little Kinston, woods	4-10-56	12	0	0	12
	5-17-56	65	0	0	65
	5-30-56	13	0	0	13
	8-8-56	2	14	0	16
	9-11-56	300	0	0	300
	10-23-56	240	0	0	240
Little Kinston, garbage dump	4-10-56	5	0	10	15
	5-30-56	7	0	0	7
	8-8-56	0	0	0	0
	9-11-56	30	0	0	30
	10-23-56	120	0	0	120
Road opposite Little Kinston	4-10-56	0	0	0	0
	5-17-56	0	0	0	0
	8-8-56	0	0	0	0
	9-11-56	35	0	0	35
Cottage near Topsail Sound	8-8-56	0	40	0	40
Delmar Beach	9-11-56	60	0	0	60
	10-23-56	170	0	0	170
Perquimans County					
Hertford, edge of town	5-28-56	0	0	0	0
	6-13-56	0	0	0	0

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
Harvey's Point	8-20-56	0	0	0	0
	9-17-56	0	0	0	0
Hertford Beach	9-17-56	0	0	0	0
		Tyrrell County			
Columbia	5-29-56	0	0	0	0
	7-23-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Sandy Point, Ferry Landing	5-29-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
8 miles outside Columbia on Sandy Point Road	7-23-56	80	0	0	80
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
3 miles outside Columbia on Sandy Point Road	7-23-56	30	0	0	30
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Woods, Edenton side of bridge	7-26-56	0	0	0	0
Route 94, 2 miles south of Columbia	7-26-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Northwest Fork	7-26-56	70	0	0	70
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
3 miles south of Northwest Fork	7-26-56	48	0	0	48
6 miles south of Northwest Fork	7-26-56	36	0	0	36
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Tyrrell - Hyde Co. line	7-26-56	15	0	0	15

Location	Date	No. of Mosquitoes Biting in a 10 Minute Period			Total No. Mosquitoes
		Aedes sollicitans	Aedes taeniorhynchus	Other Species	
		Washington County			
1 mile outside Plymouth	5-29-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Roper, outskirts of town	5-29-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
15 miles from Plymouth on Highway 64	5-29-56	0	0	0	0
	9-13-56	0	0	0	0
	10-10-56	0	0	0	0
Creswell, outskirts	9-13-56	0	0	0	0
	10-10-56	0	0	0	0

SECTION II
TABLE NO. 9
SALT MARSH MOSQUITO LIGHT TRAP CATCHES

Date	Anopheles Species	Aedes sollicitans	Aedes taeniorhynchus	Culex Species	Total
	Brunswick County - Holden's Beach - 1956				
June 12	0	1	1	0	2
14	0	1	1	0	2
19	0	0	3	0	3
21	0	0	1	0	1
26	0	0	1	0	1
" 28	0	0	2	0	2
Aug. 2	0	2	4	0	6
7	0	50	13	3	66
9	0	33	16	3	52
21	1	11	0	2	14
23	0	3	2	7	12
28	0	2	1	0	3
30	0	1	1	1	3
Sept. 4	0	1	3	0	4
7	0	0	2	1	3
	Wilmington - New Hanover County - 1956				
June 12	0	0	0	2	2
14	0	0	0	4	4
19	0	0	0	1	1
21	0	0	0	0	0
26	0	0	0	0	0
28	0	0	0	0	0
July 3	1	0	0	1	2
5	0	0	0	0	0
10	1	0	2	0	3
13	0	0	1	1	2
17	4	0	1	2	7
20	0	0	0	1	1
" 24	0	0	0	0	0
26	0	0	0	0	0
31	2	0	0	1	3
Aug. 2	0	0	0	0	0
7	0	0	2	0	2
9	0	1	0	1	2

Date	Anopheles Species	Aedes sollic-itans	Aedes taenio-rhynchus	Culex Species	Total
Aug. 14	0	0	0	0	0
16	1	0	0	1	2
21	0	1	0	0	1
23	1	0	0	0	1
28	0	0	0	0	0
30	0	0	0	0	0
Sept. 4	1	0	0	1	2
6	0	0	2	1	3
11	0	0	0	2	2
13	0	0	1	0	1
25	0	0	0	0	0
27	0	0	0	0	0
Oct. 2	0	0	0	0	0
4	0	0	0	0	0
9 & 11	0	0	0	1	1
16 & 19	0	1	1	1	3
30	0	65	11	1	77
Nov. 1	1	20	7	2	30
6	0	1	1	3	5
8	0	0	0	0	0
13	0	0	0	0	0
15	0	4	0	0	4

Jacksonville - Onslow County - 1956

June 12	0	0	1	12	13
14	0	0	0	15	15
19	0	0	0	14	14
22	0	2	1	17	20
July 13	0	3	0	3	6
18	0	0	0	0	0
20	0	0	0	4	4
24	0	14	4	6	24
26	0	0	0	1	1
31	0	0	0	1	1
Aug. 1	0	0	0	1	1
3	1	0	0	12	13
8	0	0	0	2	2
10	0	3	1	35	39
Sept. 18	0	0	0	11	11
21	0	0	0	0	0
29	0	0	0	6	6

Date	Anopheles Species	Aedes sollic-itans	Aedes taenio-rhynchus	Culex Species	Total
Oct. 3	1	0	1	10	12
6	2	0	0	0	2
10	2	0	0	1	3
12	1	0	0	1	2
	Sea Level - Carteret County - 1956				
June 27	35	330	95	0	460
29	120	210	66	21	417
July 12	570	840	60	135	1605
17	79	122	2	8	211
19	99	142	9	18	268
24	72	40	3	21	136
26	140	88	0	32	260
Aug. 13	30	200	35	50	315
14	20	380	10	0	410
15	60	305	20	5	390
	Hobucken - Pamlico County 1956				
June 12	60	365	0	100	525
14	30	285	45	16	376
20	29	58	0	65	162
22	190	370	0	130	690
27	400	235	10	585	1230
29	215	470	15	355	1055
July 4	580	80	0	240	900
6	375	20	5	240	640
11	225	55	0	405	690
13	1250	60	10	870	2190
18	180	110	0	150	440
20	100	120	0	155	375
25	155	370	5	160	690
27	175	85	10	235	505
Aug. 1	190	120	0	450	760
3	85	60	0	255	400
8	290	55	20	345	710
10	525	125	25	375	1050
22	300	525	25	175	1025
24	100	120	0	400	620
28	23	9	0	3	35
31	70	60	0	90	220
Sept. 5	325	145	0	130	600
7	960	120	0	460	1540

Date	Anopheles Species	Aedes sollic-itans	Aedes taenio-rhynchus	Culex Species	Total
Oct. 3	11	3	0	16	30
5	70	0	5	155	230
	Swan Quarter - Hyde County - 1956				
June 15	15	72	0	6	93
19	27	17	1	21	66
21	15	26	0	5	41
26	23	26	2	7	58
29	17	11	0	3	31
July 3	123	0	0	6	129
5	3	3	2	1	9
10	330	15	0	30	375
13	51	7	1	19	78
18	0	0	0	0	0
20	0	11	0	32	43
24	120	31	1	34	186
26	60	100	0	90	300
31	30	15	0	60	105
Aug. 2	19	5	0	28	52
23	60	4	0	120	184
28	120	20	0	130	270
31	100	25	0	100	215
Sept. 4	72	18	4	46	140
6	105	50	5	60	220
11	32	11	1	38	82
13	15	3	0	12	30
Oct. 2	20	2	0	20	42
4	40	0	0	44	88
	Manteo - Dare County - 1956				
June 29	0	20	5	235	260
July 5	32	3	1	51	97
10	30	20	0	270	320
12	10	5	2	58	75
17	6	23	0	103	132
19	2	111	0	31	144
26	11	31	0	123	165
28	4	17	0	8	29
Aug. 3	7	8	0	97	112
5	10	4	1	58	73

Date	Anopheles Species	Aedes sollic-itans	Aedes taenio-rhynchus	Culex Species	Total
Aug. 28	4	2	0	60	66
31	1	0	0	7	8
Sept.15	0	0	0	2	2
17	0	0	0	0	0
	Cape Hatteras National Seashore Park - Dare County - 1956				
June 14	0	11	0	0	11
19	0	12	0	0	12
22	0	10	0	4	14
26	0	16	0	4	20
28	0	1	0	1	2
July 3	0	24	4	2	30
5	0	0	0	0	0
12	2	43	2	0	47
14	0	4	0	3	7
18	95	1060	0	205	1360
20	5	250	0	10	265
25	50	500	0	60	610
27	500	660	0	160	1320
Aug. 1	145	305	0	480	930
3	38	55	0	129	222
8	3050	450	25	850	4375
10	29	11	0	18	58
15	25	27	0	135	187
17	10	19	0	11	40
22	4	4	0	4	12
24	4	12	0	63	79
28	100	470	0	240	810
31	4	0	0	5	9
Sept. 4	5	25	4	61	95
6	0	1	0	7	8
11	13	11	0	63	87
13	5	1	1	29	36
18	45	40	0	130	215
26	70	40	0	350	460
27	5	5	0	20	30
Oct. 2	1	1	0	10	12
4	1125	150	15	2445	3735
9	30	20	0	410	460
16	15	4	0	27	46
18	35	5	0	245	285
25	25	50	0	50	125

Date	Anopheles Species	Aedes sollic-itans	Aedes taenio-rhynchus	Culex Species	Total
Oct.30	0	0	0	0	0
Nov. 1	210	70	0	240	520
6	65	0	0	0	65
8	0	10	0	40	50
13	2	0	0	34	36
15	48	11	0	21	80

SECTION III
DISCUSSION OF ENTOMOLOGICAL DATA

A. Rainfall Relationship to Mosquito Population.

Chart No. 1 shows the effect of rainfall on adult mosquito populations on Bodie Island. The vertically-lines bars represent rainfall in inches. The bars, although similar in appearance, represent a varying period of consecutive days of rainfall heavy enough to leave standing water, with the final right dark line being the last day of rain. The bars are also pictured as the total number of inches which have fallen during this period. The graph line depicts average nightly capture per week of adult salt marsh mosquitoes. Both the light trap captures and rainfall readings came from the same locale on Bodie Island.

This chart clearly illustrates rainfall effect on the build-up of mosquito populations. After the soaking of the ground in May, consequent rainfall served to form standing pools of water. Thus, it can be seen that the two periods of rainfall in June and the first heavy period in July served to "trigger" the first peak population. Then the second two periods in July and the first two in August served as boosters to an already high population and a record capture of 2,217 adult mosquitoes resulted.

Further evidence of this direct relation between inches of rainfall and mosquito population size is shown in Table No. 10.. It can be seen that in Wilmington during the months of June, July, August, and September there was a minus or rainfall deficiency of from -0.13 inches to -4.85 inches from the normal expected rainfall. In this same period there were no mosquito outbreaks or complaints in the city. In October, Wilmington received heavy rains in the middle of the month. Results, light trap captures increased from 1 mosquito per evening to 77 per evening. Floods of calls concerning mosquitoes poured into the Health Department in Wilmington on October 31st and November 1st. Previous to this period, very few complaints had been made in this area, but with their first truly heavy rains which thoroughly soaked the ground and left standing pools of water, mosquitoes began breeding in abundance and an outbreak was the result.

CHART NO. 1 EFFECT OF RAINFALL ON ADULT MOSQUITO POPULATIONS
(BODIE ISLAND)

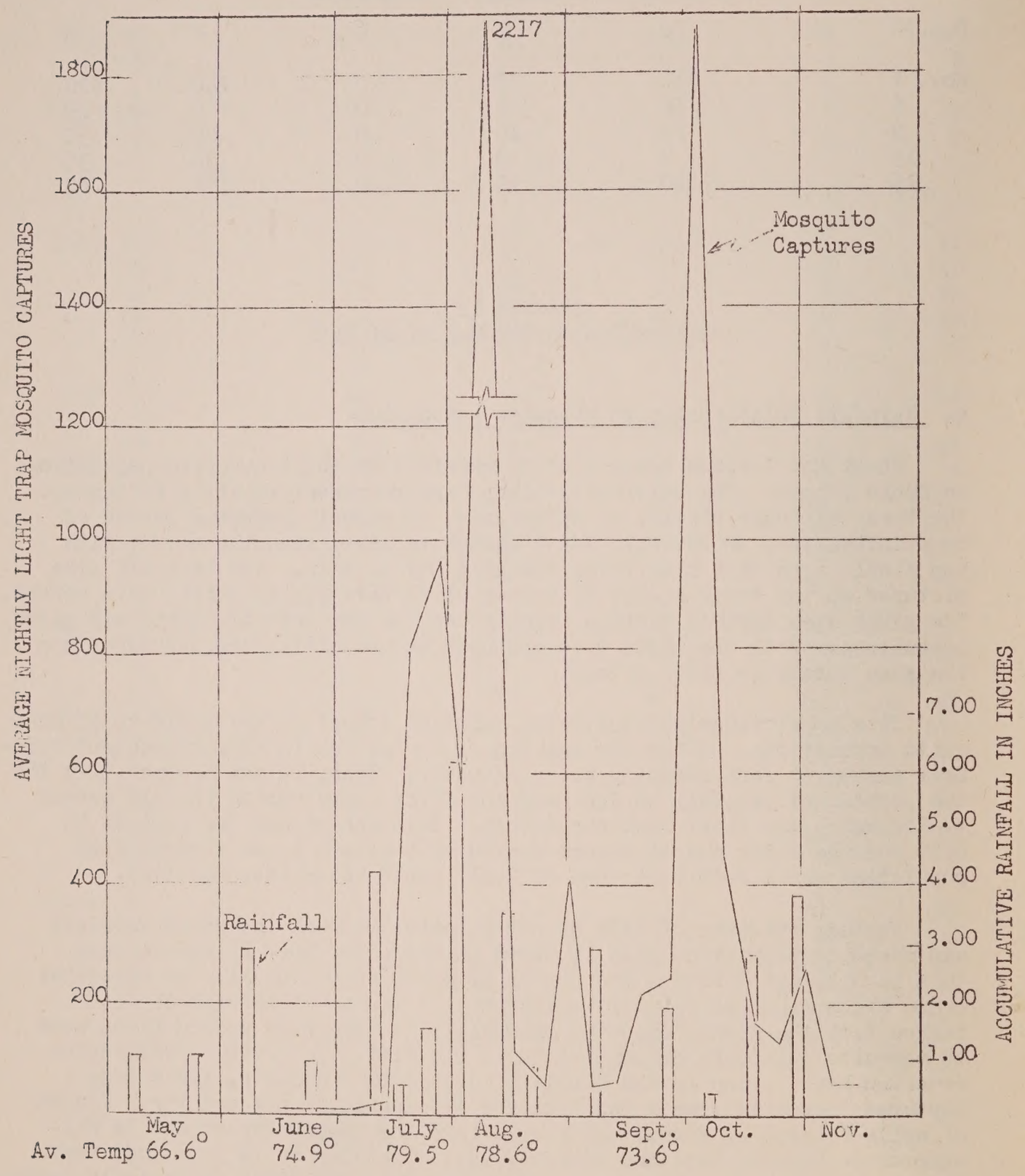

TABLE NO. 10

City	Month	Inches of Rainfall Departure From Normal	Average Temperature	Monthly Average Mosquito Light Trap Capture	Average Monthly Mosquito Biting Count
Wilmington	May	+5.69	69.7		0
	June	-0.13	76.8	1	5
	July	-4.85	81.3	2	1
	Aug.	-1.39	79.6	1	1
	Sept.	-3.64	72.4	1	4
	Oct.	+4.47	66.8	17	20
	Nov.			12	20
Swan Quarter	May	-.05	68.5		
	June	-2.09	75.6	58	30
	July	+1.49	79.1	133	200
	Aug.	-2.13	78.5	180	80
	Sept.	0	72.6	118	0
	Oct.	+8.40		65	105
	Nov.				20

B. Salt Kill Area Relationship to Mosquito Population.

Correlation of the salt kill acreage data compiled by the engineer and mosquito population data gathered by the entomologist is presented in the table below:

TABLE NO. 11

County	Salt Kill Acreage	Average No. of Biting Mosquitoes Caught Per Month	Average No. of Biting Mosquitoes Caught Per Catch
Beaufort	2,611	302	50
Carteret	5,011	756	54
Dare	31,904	1,238	83
Hyde	28,354	776	79
Onslow	2,146	511	64
Pamlico	12,755	819	67
Brunswick	0	211	27
Currituck	0	95	18
New Hanover	0	33	5
Tyrrell	0	70	11

It would seem to indicate from the above table that increased breeding area resulting from salt intrusion results in much higher mosquito populations.

CAPACITY OF LOCALITIES TO PARTICIPATE IN THE COST OF MOSQUITO CONTROL OPERATIONS

In determining the capacity of localities to participate in the cost of mosquito control operations, many complex problems are presented.

It is apparent from the table showing tax data that a wide diversity of income exists among the counties with salt marsh mosquito problems. Unfortunately, the population densities and potential sources of revenue are, in most instances, in inverse proportion to the size of the counties, salt marsh areas, and extent of mosquito problems. In other words, where the need is greatest there is the least ability to provide local funds.

Acting alone very few communities are capable of providing enough money to finance the total cost of a balanced mosquito control program, that would include adulticiding, larviciding, drainage, dyking, and filling, to give protection against insects that fly thirty miles or more. It is clear, however, that none of these communities, regardless of their financial status, can afford not to control mosquitoes, when consideration is given the certain retardation in economic development, the constant threat to public health, and adverse effects on comfort and general welfare that would continue in the absence of control measures.

In our efforts to ascertain factors bearing on the capacity of local communities to finance mosquito control costs, information was obtained from numerous sources.

Most of the data in Table No. 12 showing information, pertaining to taxation, was compiled from records of the Local Government Commission. As that agency did not have complete reports from all of the counties involved, visits were made to the court houses in some of the counties by members of our staff in order to get the missing data. The percent of actual valuation on real property was obtained from the North Carolina Revenue Department.

Table No. 13 showing populations and land areas was compiled from Rand McNally's map of North Carolina with census figures for 1950 shown.

TABLE NO. 12
TAX COLLECTIONS FOR FISCAL YEAR 1954-55

	Total Assessed Valuation	% of Actual Valuation of Real Property	Tax Rate	Total Property Tax Levy	Total Property Taxes Collected	Taxes Collected From Other Sources	Total Tax Collected	Uncollected Property Taxes **
Beaufort	37,070,519	33 1/3	1.30	531,006.40	527,191.70	88,500.00	615,691.70	3,814.70
Brunswick	15,357,311	30	1.80	291,300.34	239,163.00	7,964.45	247,127.45	52,137.34
Camden	5,230,623	60	1.75	91,282.96	82,605.73	5,872.26	88,477.99	8,677.23
Carteret	22,968,520	40	1.80	422,434.35	403,973.77	89,844.00	493,817.77	18,460.58
Chowan	11,811,337	35	1.53	185,890.98	173,049.77	13,402.22	186,451.99	12,841.21
Craven	36,228,148	25	2.00	742,852.38	675,753.10	142,054.23	817,807.33	67,099.28
Currituck	7,860,030	50	.90	65,983.70	63,740.38	9,740.84	73,481.22	2,243.32
Dare	16,527,762	65	.90	154,453.70	132,111.18	25,740.22	157,851.40	22,342.52
Hyde	8,338,276	75	1.38	117,455.14	97,119.25	8,116.76	105,236.01	20,335.89
Jones	6,512,933	40	2.00	134,708,66	124,812.20	8,127.39	132,939.59	9,896.46
New Hanover	104,541,704	40	1.20	1,291,540.36	1,234,319.66	184,004.40	1,418,324.06	57,220.70
Onslow	33,478,842	50	1.28	483,929.09*	360,819.88*	47,894.99*	408,714.87*	46,731.01
Pamlico	10,396,398	50	1.30	139,737.76	130,478.94	1,026.52	131,505.46	9,258.82
Pasquotank	25,909,962	60	1.48	380,817.78	369,294.75	47,612.25	416,907.00	11,523.03
Pender	15,501,799	60	1.50	242,062.24	223,134.30	9,793.06	232,927.36	18,927.94
Perquimans	8,075,500	50	1.65	138,335.46	134,927.34	5,300.48	140,227.82	3,408.12
Tyrrell	4,473,900	25	1.72	76,951.08	71,459.25	13,970.00	85,429.25	5,491.83
Washington	11,248,808	50	1.70	191,229.74	179,487.84	20,771.15	200,258.99	11,741.90

* For Fiscal Year 1955-56
** The uncollected property taxes represent the amounts given on reports made to the Local Government Commission prior to November 1, 1956

TABLE NO. 13
POPULATIONS AND LAND AREAS

County	Total	Rural	Urban	Land Area Sq. Mi.	Pop. Per Sq. Mi.
Beaufort	37,134	24,908	12,226	831	45
Brunswick	19,238	17,490	1,748	873	22
Camden	5,223	5,023	200	239	22
Carteret	23,059	14,703	8,356	532	43
Chowan	12,540	8,072	4,468	180	70
Craven	48,823	33,011	15,812	725	67
Currituck	6,201	6,001	200	273	23
Dare	5,405	4,770	635	388	14
Hyde	6,479	6,267	212	634	10
Jones	11,004	10,535	469	467	24
New Hanover	63,272	17,149	46,123	194	325
Onslow	42,047	37,005	5,042	756	56
Pamlico	9,993	9,540	453	341	29
Pasquotank	24,347	11,662	12,685	229	106
Pender	18,423	16,810	1,613	857	22
Perquimans	9,602	7,506	2,096	261	37
Tyrrell	5,048	3,887	1,161	399	13
Washington	13,180	8,694	4,486	336	39
Totals	361,018	243,033	117,985	8,515	43
State	4,061,929			49,142	83
% of State	8.9%			17.3%	

In Table No. 14 showing financial data pertaining to families and individuals, the information concerning recipients of public welfare aid was obtained from the North Carolina Department of Public Welfare. Individuals given such aid are those securing old age assistance, dependent children under eighteen, the permanently and totally disabled, as well as those who qualify for general assistance. Median family incomes and employment rates were taken from the Economic Survey of North Carolina's 43 Eastern Counties that was made by North Carolina State College. Populations shown are taken from the records of the North Carolina State Board of Health, Public Health Statistics Section, and represent the estimated populations on July 1, 1955.

TABLE NO. 14
RECIPIENTS OF PUBLIC WELFARE AID

County	Population		Welfare Recipeints		Median Family Income
	Number	Percent Employed	Number	Percent of Population	
Beaufort	37,501	33.1	961	2.58	$1,421
Brunswick	20,346	30.4	605	2.98	1,459
Camden	5,109	31.4	225	4.39	1,431
Carteret	25,563	31.3	847	3.32	2,141
Chowan	13,049	32.6	171	1.30	1,475
Craven	58,026	27.8	1,832	3.17	2,078
Currituck	5,933	32.1	269	4.52	1,599
Dare	5,069	27.8	270	5.32	1,641
Hyde	5,755	31.5	363	6.32	944
Jones	11,046	28.9	452	4.08	1,391
New Hanover	71,326	38.2	2,390	3.34	2,250
Onslow	54,705	20.0	796	1.43	2,293
Pamlico	10,145	29.1	471	4.63	1,358
Pasquotank	26,332	34.0	491	1.88	1,969
Pender	18,796	32.1	570	3.05	1,203
Perquimans	9,508	31.5	316	3.32	1,259
Tyrrell	4,780	32.3	308	6.42	1,145
Washington	13,631	31.4	270	1.99	1,824
Above Counties	396,620		11,607	2.83	$1,605
For State	4,319,342		122,875	2.83	$2,121

An examination of the data presented in the foregoing tabulations reveals that Beaufort, Carteret, Craven, Brunswick, New Hanover, Pender, Onslow, and Pasquotank counties are more capable of financing mosquito control operations than the other counties affected by salt marsh mosquitoes. In all of these counties with the exception of Brunswick, Pender, and Beaufort, the median family income is above or just slightly below the state average, and in several of them the tax potential exceeds by 100% that of any other of the eighteen counties involved. It is believed that it would be practical for these counties, or parts thereof, alone or in combination with other contiguous counties or parts of such counties, to organize mosquito control districts and engage in all standard methods of mosquito control if outside financial aid on a 50-50 matching basis were provided.

With the present assessed valuations, if such districts were to levy a tax rate of ten cents per $100 valuation, the following yields would be obtained annually:

Beaufort	$37,070	New Hanover	$104,542
Carteret	22,969	Onslow	33,479
Craven	36,228	Pasquotank	25,910
Pender	15,501	Brunswick	15,357

As there are no salt marsh mosquito breeding areas in Jones, Washington, Chowan, and Perquimans counties, the problem is to provide protection against those that fly in from the outside. This can be accomplished by the inclusion of these counties, or parts of these counties, in mosquito control districts with other counties, or parts thereof. It is believed that their financial status would enable them to pay their fair share of the cost if outside funds are provided on a 50-50 matching basis. If no mosquito control districts are formed in contiguous territories, protection against salt marsh mosquitoes in these counties should, in most areas, be limited to adulticiding around the centers of population. The ability to finance this type of operation, with outside help, has been demonstrated. As the density of annoying fresh water mosquitoes becomes very high in this group of counties during the warm months, equal importance should be attached to the control of these species. With present assessed valuations, if an additional levy of 10¢ per $100 valuation were made for mosquito control the following yields would be obtained annually:

Chowan	$11,800	Jones	$6,513
Washington	11,248	Perquimans	8,075

In Camden, Currituck, Dare, Hyde, Pamlico, and Tyrrell counties, the economic status is not only far below that of North Carolina as a whole but is much lower than in the other salt marsh mosquito counties.

With the present assessed valuation, if an additional levy of 10¢ per $100 were made for mosquito control the following yields would be obtained annually:

Dare	$16,528	Hyde	$ 8,338
Currituck	7,860	Tyrrell	4,474
Camden	5,231	Pamlico	10,396

Although the potential revenue from property tax is much higher in Dare than in the other counties included in this group, it is placed herein on account of the large salt marsh acreage. This county has, including the salt kill area, a total of 112,019 such acres.

The low economic status of these six counties is reflected by the data given in the foregoing tables. Median family incomes are:

Dare	$1,641	Hyde	$ 944
Currituck	1,599	Tyrrell	1,145
Camden	1,431	Pamlico	1,358

While, for the eighteen salt marsh counties, the average percentage of public welfare aid recipients is exactly the same as that for the State as a whole; for these six counties it is deplorably high. Con-

trasted with average of 2.83% for the state, these counties have the high rates given below:

Dare	5.32%	Hyde	6.32%
Currituck	4.52%	Tyrrell	6.42%
Camden	4.39%	Pamlico	4.63%

It is not believed that, with outside aid available on a 50-50 matching basis, it would be practical for these six counties to engage in all aspects of mosquito control. For the present, control measures would, of necessity, be limited to space spraying to kill adult mosquitoes with a gradual increase in types of activity as economic conditions improve. Such improvements should take place in Dare and Currituck counties at a rapid rate if mosquito densities are held to a bearable limit. In the meantime, these counties should explore every possible source from which additional revenue could be derived.

In all of the eighteen counties afflicted with salt marsh mosquitoes, revenue could be increased by more diligent efforts on the part of officials responsible for the collection of taxes. Nearby, Gates County with a total property tax levy of $103,467.80 reports only $492.00 being uncollected at the time these data were obtained from the Local Government Commission.

No effort has been made to ascertain the capacity of towns and cities to finance salt marsh mosquito control operations. During the last two summers, the ability to obtain reasonable control by adulticiding has been demonstrated. There is no town or city in the area that cannot afford to finance this type of activity. It is also true that no municipality can, acting alone, afford to apply larvicidal or permanent control against salt marsh mosquitoes, to an effective degree, due to the long flight range of these insects.

THE EFFECTS OF MOSQUITO CONTROL OPERATIONS ON WILDLIFE AND OTHER NATURAL RESOURCES

This section is intended to point out the value of wildlife resources to the people of North Carolina. It is not our intention to emphasize the desirability of any one type of permanent salt marsh mosquito control for all conditions. We believe that dyking, drainage, and filling are all effective under appropriate conditions, and are of the opinion that each should be given careful consideration before making any decisions as to the method to be used.

Each site should be studied on the basis of complete engineering and entomological data, and full consideration should be given to the proximity of human population, probable damages to natural resources, and the expected effectiveness of the various methods.

Fish and wildlife resources have provided a livelihood and recreation for people in Eastern North Carolina since the first settlers arrived. Today the income of many coastal residents is directly dependant on the abundance of fish, game, fur animals and other products of the sounds and marshes through the well developed sport fishing and hunting and commercial fishing industries.

With a steady increase in the number of people and the shifting of the population from rural to urban ways of life, the demand for healthful outdoor recreation and seafood products will continue to increase. Adequate fish and wildlife resources to meet the growing recreational needs are important to North Carolina's growth as an industrial and agricultural state. These resources are essential to the resort industry.

Many of our important game species such as geese, ducks, rails, and snipe, and most of our fur animals as muskrats, mink, otters, and raccoons, make use of our coastal waters and marshes. The importance of the coastal marshes to shrimp, crabs, and fish has been studied but little and is not well understood; but it is almost certain that most marsh areas are important nursery grounds for some of our important commercial species and are of major importance as food producing areas for many others.

Mosquito control operations in some of the Atlantic coast states have severely damaged fish and wildlife habitats through wholesale drainage and filling of marsh areas. On the basis of the experiences of other states, we now know that effective salt marsh mosquito control can be achieved without this wholesale destruction of valuable fish and wildlife. It is imperative to the future well-being of North Carolina that planned mosquito control operations give ample consideration to the numerous resources involved. It should always be kept in mind that no single mosquito control method is practical for all mosquito breeding sites. Planning for control operations should consider the overall effects of the proposed operations and selection of a method for each site which has a minimum of adverse effects on natural resources. Consideration should also be given to the long range effectiveness of the program and the best method should

be selected from the standpoint of initial development and annual maintenance costs plus the ability of the treated area to supply recreational opportunity and income to the community.

The comparative effects of the principal mosquito control methods on fish and wildlife resources are considered briefly here together with some of the obvious advantages and disadvantages. These methods have already been described under the section on Standard Methods of Salt Marsh Mosquito Control.

Adulticiding, when properly conducted, does not greatly damage wildlife populations since it is usually conducted only in towns and densely populated areas.

Larviciding, the destruction of the immature mosquitoes by use of insecticides, can be highly destructive to many forms of wildlife. Wholesale spraying of insecticides can be destructive to fish, crabs, shrimp, amphipods, worms, spiders, insects, and similar animal life, many of which are important predators of mosquito larvae. This destruction can be damaging not only to populations of young crabs and fish, the adults of which are important commercial items, but it also may destroy the abundance of animal life which is a basic food supply of important commercial and sport species. It may require several years for these populations to recover from such damage.

Larviciding is an expensive control method which must be repeated at frequent intervals and, no matter how long it is practiced, will never cure the mosquito problem. Therefore, its use should be restricted to known mosquito breeding sites and the rate of application should be carefully controlled using only insecticides which have been tested and proved to have a minimum of damaging effects to other forms of life. Larviciding should not be substituted for permanent control methods.

Permanent control methods are based on the elimination of breeding habitats for mosquitoes. There are three principal methods now commonly employed. These are drainage, filling, and impounding of water on the breeding site.

In the past, drainage has been the most widely employed permanent control method. Drainage of wetland areas is generally damaging to waterfowl, fur animals, and other forms of wildlife. These damages occur both from the direct lowering of the water level and from changes in the vegetation which result from the lowered water table and diversion of underground freshwater seepage. Drainage may also lower water tables in surrounding areas and result in severe soil subsidence due to aeration where soils are of an organic type. In these same areas, forest fire hazards may be increased considerably by lowered water tables.

Drainage may be a less effective control method in parts of North Carolina than in some other states because most of the salt marsh mosquito producing areas north of Beaufort are subject to flooding by wind tides. Occasionally such tides might be so prolonged as to produce a hatch of mosquitoes despite the drainage system. Wind tides may cause

frequent blockage of ditches by debris where lunar tides are so slight as to provide no regular flushing action. Such blockage may result in relatively high maintenance costs in some areas. Even if this blockage does not occur, a periodic maintenance of drainage ditches is necessary.

Wildlife, soil, and forest losses from drainage can be minimized by placing weirs in ditches to maintain water levels at just below the marsh surface. The same effect may be obtained at less cost by digging blind ditches with no outlet or a series of radial ditches which connect shallow pools with a deep central pool. These methods allow for drainage of the shallow mosquito producing pools, and provide access for predaceous fish and insects from the deep water areas into the shallow ones during prolonged periods of high water. In New Jersey, effective control has been obtained economically by using draglines or dynamite to deepen shallow mosquito producing pools, thus providing a reservoir for mosquito fish. Such deepened pools have been heavily used by waterfowl and muskrats.

Filling is an expensive control method and probably will be applicable only incidental to regular dredging operations. Loss of wildlife habitat is almost complete since the marsh area is filled and no longer exists. Additional and even more severe damage to wildlife habitat can result from the actual removal of shoal areas which support important oyster or aquatic plant beds and associated plant and animal life important in the food chain. Much of the fine silt of dredging operations flows overboard and may be carried for miles by currents. The resultant turbidity prevents growth of aquatic plants and a fine layer of newly deposited silt on the bottom may be resuspended by any water movement thus perpetuating for years such adverse conditions.

Dredging spoil must be deposited with caution or a more extensive mosquito breeding area may result than the one destroyed. Grading or ditching of filled areas may be necessary to eliminate depressions caused by uneven deposition of spoil or resultant irregular suppression of the unstable marsh soils by the overburden.

Impounding is an effective mosquito control method and is probably the least damaging to wildlife. Dykes and water control structures are utilized to permanently flood marsh areas and maintain controlled water levels.

Permanently flooded impoundments provide mosquito control by covering the areas sought by salt marsh mosquitoes for egg laying and by maintaining large populations of predaceous fish and insects. Adequate water levels can be maintained on many North Carolina sites by utilization of run-off from adjacent high lands, rainfall, and retention of water from high wind tides. At other sites pumping will be necessary at certain periods of the year.

In many instances fish and wildlife may be benefited by impoundments. In Delaware research studies, an impounded marsh was shown to produce from six to eighteen muskrats per acre as compared to five muskrats per acre

on unimpounded tidal marsh. The comparative cash return from fur animals in 1950-1951 was $10.98 per acre on the unimpounded marsh and ran as high as $46.00 per acre on the best portion of the impounded marsh. Additional revenue from duck blind rental and sale of carp and snapping turtles brought the 1950-1951 revenue up to $11.98 per acre on unimpounded marsh and $21.93 per acre on the 1,193 acre impoundment marsh. It is not anticipated that North Carolina marshes will be as productive as Delaware marshes; but experiments in Currituck County have shown that, under management, North Carolina marshes can produce six times more muskrats than when unmanaged.

Many North Carolina salt marshes do not now produce any revenue because muskrats are scarce or absent due to tidal fluctuations, salt water, and the dense coarse salt marsh vegetation which is unsuitable for food. The fact that some of these marshes were fresher and produced muskrats before the dredging of the Intracoastal Waterway is ample indication that they can again produce muskrats if water conditions are stabilized and freshened by impounding for mosquito control. Brackish water impoundments at the Pea Island National Wildlife Refuge support high muskrat populations in a formerly salt water area which had no muskrats.

In some salt marsh areas, salinities will probably be too high to produce muskrats but such impoundments, if properly designed, could have considerable potential for waterfowl use or might produce shrimp or fish in commercial quantities. Experiments in South Carolina have shown that commercial size shrimp, crabs, and fish can be produced in salt water ponds.

The impounding method of control will not be applicable on sites which do not have suitable watertight soils or where there will be interference with farm land drainage. Impounding may not be practical for sites within one mile of densely populated areas since a few short-flight-range mosquitoes may be produced occasionally.

Some storm damage to impoundments can be anticipated but with properly designed dykes and structures, repair costs might be less than that of removing storm debris from numerous drainage ditches. Proper impoundment design would include low, broad-based dykes with heavy vegetative cover, adequate emergency spillways, and placement of dykes to utilize protection afforded by land masses.

Obvious advantages of impoundments are preservation or enchancement of wildlife habitat, and maintenance of ground water levels in forested areas to minimize fire hazards and prevent subsidence of organic soils. Once dykes have settled and are well protected by vegetation, maintenance costs should be relatively low.

The potential income from leasing of trapping and waterfowl hunting rights and possible seafood production on impoundments is a decided advantage over non-revenue producing methods of control. This income could defray all or part of the annual maintenance cost, thereby relieving the control districts of this financial burden in addition to converting hitherto low productive lands into a community asset.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE CREATION OF MOSQUITO CONTROL DISTRICTS AND TO DEFINE THEIR POWERS AND DUTIES

The General Assembly of North Carolina do enact:

Section 1. Statement of purpose. For the purpose of preserving and promoting the public health and welfare by providing for the control of mosquitoes and other arthropods of public health significance, the creation of mosquito control districts, as hereinafter provided, is hereby authorized. A mosquito control district may be comprised of one or more contiguous counties or contiguous parts of one or more counties.

Sec. 2. Procedure for incorporating district. A mosquito control district shall be incorporated as hereinafter set out:

(a) Ten percent (10%) or more of resident freeholders within the proposed district may petition the board of county commissioners of the county in which all or the major portion of the petitioning freeholders of the propcsed district are located, setting forth the boundaries of the district, and a suggested name for the district. Upon receipt of such petition the board of county commissioners, through their chairman, shall notify the State Board of Health and the chairman of the board of county commissioners of any other county or counties in which any portion of the proposed district lies of the receipt of said petition and shall request that a representative of the State Board of Health hold a joint public hearing with the said county commissioners concerning the creation of the proposed mosquito control district. The representative of the State Board of Health and the chairman of the board of county commissioners shall name a time and place within the proposed district at which the public hearing shall be held. The chairman of the board of county commissioners shall give prior notice of said hearing by posting a notice at the courthouse door of the county and also by publication in a newspaper published in said county at least once a week for four successive weeks. If no newspaper is published in said county such publication shall be made in a newspaper with wide circulation in said county; and in the event said hearing is to be before a joint meeting of the boards of county commissioners of more than one county because the land to be affected lies in more than one county, then a like publication and notice shall be made and given in each of said counties. In the event that all matters pertaining to the creation of this district cannot be concluded at the hearing, any such hearing may be continued to a time and place agreed upon between the chairman and the board of county commissioners and the representative of the State Board of Health.

(b) If, after such hearing, the State Board of Health (after consultation with the representative who participated in the public hearing) and the county commissioners concerned deem it advisable to comply with the request of said petition and feel that the district should be created and established, the county commissioners of the county or counties con-

cerned shall submit to the qualified voters of the entire proposed district, at an election called for that purpose, the question of whether or not the district shall be created.

(c) Prior to the submission of the question of the formation of the district to the voters within said district, the representative of the State Board of Health and the county commissioners concerned may make minor deviations in defining the boundaries of the proposed district, from those described in the petition, when they determine that it is advisable in the interest of the public health; provided that 10% of the resident freeholders within the revised boundaries have signed the petition proposing the creation of said district.

(d) At the election provided for in subsection (b) above, the county commissioners of the counties concerned shall provide one or more polling places in the proposed district, shall provide for a registrar or registrars and judges of election at the voting places, shall provide for the registration of all qualified voters residing in said proposed district, shall cause to be prepared the necessary ballots for voting at the election, shall fix the time and place for holding the election, and shall conduct said election in every other respect according to the provisions of the laws governing general elections so far as they may be applicable. The cost of holding the election shall be paid by the counties concerned according to their pro-rata portion of the total number of residents within the district.

(e) The form of the question as stated on the ballot shall be in substantially the words: "For creation of the (Here insert name) Mosquito Control District and the levy of a special tax for mosquito control purposes," and "Against creation of the (Here insert name) Mosquito Control District" and the levy of a special tax for mosquito control purposes". Such affirmative and negative forms shall be printed on one ballot, containing squares opposite the affirmative and negative forms, in one of which squares the voter may make a mark (X).

(f) If a majority of the qualified voters voting at the election vote in favor of creation of the district and the levy of the special tax, the board or boards of county commissioners shall declare that such district exists, and shall adopt a resolution to that effect.

Sec. 3. Extension of boundaries of district. The boundaries of any mosquito control district may be extended so as to include contiguous territory upon the presentation of a petition signed by fifty-one percent (51%) or more of the resident freeholders within the area to be annexed to the chairman of the governing board of the district. Upon approval of the governing board of the district, the State Board of Health, and the county commissioners of the counties in which the proposed district and extension lie, said county commissioners shall declare that such territory is in every respect a part of the district to which it has been annexed, and shall adopt a resolution to that effect. The petition shall describe the territory which the petitioners desire to be added to the district and shall identify the district to which it is

desired the territory shall be added.

Sec. 4. Governing body for mosquito control districts. Each mosquito control district shall be governed by a board to be known as "The Board of Mosquito Control Commissioners of _____ District." This board shall be composed of five members, all residents of the district.

Upon the adoption of a resolution creating a mosquito control district located wholly within one county, the board of county commissioners of that county shall thereupon hold a meeting for the purpose of selecting three of the five members of the governing board of said mosquito control district. One of the members shall be appointed for a term of one year, another for a term of two years, and the third for a term of three years, with all appointments thereafter being for a term of three years. One of the two remaining members of the governing board shall be appointed by the State Health Officer and the other by the Director of the Wildlife Resources Commission. The term of office of the two members not appointed by the county commissioners shall be at the pleasure of the appointing authority.

Upon the adoption of a resolution creating a mosquito control district lying in more than one county, the boards of county commissioners of the counties concerned shall hold a joint meeting for the purpose of selecting three of the five members to the governing board of said mosquito control district. One of the members appointed at said joint meeting shall serve for a term of one year, one for a term of two years, and the third for a term of three years. Thereafter all appointments shall be for a term of three years. The three members appointed at said joint meeting shall be selected according to the pro-rata portion of the total residents of the district residing in each of the counties located within the district and shall be named by the county commissioners of the county within which they reside. If, as a result of appointment according to this formula, one or more of the counties included within the district has no representation appointed by its county commissioners, an additional member may be appointed for each such county without representation by the county commissioners of such county. One of the two remaining members of the governing board shall be appointed by the State Health Officer and the other by the Director of the Wildlife Resources Commission. The term of office of the two members not appointed by the county commissioners shall be at the pleasure of the appointing authority.

The governing board shall elect from its membership a chairman, vice chairman and secretary. The members of the governing board are to serve without compensation except actual expenses for travel in connection with their duties as a member of the governing board of said district.

Vacancies in the membership of the governing board of any mosquito control district are to be filled by the authority originally making the appointment from which the vacancy occurred.

Sec. 5. Corporate powers. When a mosquito control district is organized as herein provided the mosquito control commissioners of the district selected under the provisions of this act shall be a body politic and corporate and as such may sue and be sued in matters relating to such mosquito control district. In addition, such board shall have the following powers:

1. To cause taxes to be levied, at a rate not to exceed .35 per $100 of taxable property, and collected upon all taxable property within the district sufficient to pay all obligations incurred by the district in the performance of its lawful undertakings. The taxes authorized to be levied and collected under this subsection are to be collected by the established tax collection authorities and in accordance with established tax collection procedures of the county within which the property lies. Such tax shall be deemed to be for a special purpose, and is a necessary expense for which the special approval of the General Assembly is hereby given.

2. To accept gifts or endowments, and to receive federal and state grants-in-aid. All money or property acquired under this section or subsection (1) of this section, or any other source, shall be deposited in a separate fund to be used solely for the purpose of carrying out the provisions of this act. Funds so deposited shall be withdrawn by warrants signed by the chairman of the governing board of the district, and countersigned by the secretary.

3. To take all necessary and proper steps to prevent the breeding of mosquitoes and other arthropods of public health significance within the district, and to destroy adult mosquitoes and other arthropods of public health significance found within the district.

4. To conduct arthropod control measures in cooperation with individuals, firms, corporations, and federal, state, and local governmental agencies.

5. To enter all places within the district for the purpose of inspection and survey, whether on privately owned land or not, and to treat with proper means all places, wherever situated, that are breeding mosquitoes or other arthropods of public health importance and to do all things necessary or incident to the power herein granted.

6. To acquire, either by purchase, condemnation or otherwise and to hold real and personal property, easements, rights-of-way or other property necessary or convenient for the accomplishing of the purposes of this act. Any land which has been acquired by the board and improved by drainage, filling, dyking or other treatment, and other real property held by the board may be sold or leased by the board through the process of competitive bidding. All condemnation proceedings are to be in accordance with the provisions of Chapter 40 of the General Statutes of North Carolina.

7. To employ necessary personnel, fix salaries, purchase equipment,

supplies and materials, make contracts, rent office or storage space, and perform other administrative functions necessary for the purpose of carrying out this act.

8. To borrow money in gross amounts not to exceed the anticipated tax receipts for one year.

9. To reimburse members and employees of the board for actual expenditures incurred in authorized travel.

10. To employ a district superintendent who is an engineer, entomologist or otherwise qualified as an arthropod control specialist. The professional qualifications of the superintendent must be approved by an authorized representative of the State Health Officer.

Sec. 6. Adoption of a plan of operation. Sixty (60) days prior to the initiation of operations, the governing board of each mosquito control district must submit to the State Health Officer, in such detail as may be required by the State Health Officer, a plan of procedure and operation. The State Health Officer, through his authorized representative, shall have authority to approve, modify, or take other appropriate action in regard to such plans. No contract may be entered into, program embarked upon, or work begun prior to the approval of the plan by the State Health Officer or his authorized representative.

In addition, the governing board of each mosquito control district must submit to the State Health Officer at least sixty (60) days prior to the expiration of each fiscal year, in such detail as the State Health Officer may require, a plan of procedure and operation for the ensuing fiscal year. The State Health Officer, through his authorized representative, shall have authority to approve, modify, or take other appropriate actions in regard to such plans for the ensuing fiscal year. No contract may be entered into, program embarked upon, or work begun or continued prior to the approval of said plan by the State Health Officer or his authorized representative.

Sec. 7. State assistance to mosquito control districts. The State Board of Health is authorized to provide engineering and entomological consultation to all organized mosquito controlled districts.

Funds appropriated to the State Board of Health for mosquito control shall be utilized to aid mosquito control districts, and other local governmental units, in accordance with the rules and regulations adopted by the State Board of Health. In no case shall the monetary value of such aid exceed funds provided locally for temporary control measures such as larviciding or adulticiding, nor twice the local funds provided for improvements such as drainage, filling, and dyking. State aid shall not be given to mosquito control districts or other local governmental units until proof has been received by the State Board of Health that the required local funds are available and will be used for mosquito control in accordance with the plan approved by the authorized representative of the State Health Officer.

In emergency situations where proved outbreaks of mosquito borne diseases occur, the State Health Officer is authorized to utilize the appropriated state funds to suppress such outbreaks.

Sec. 8. Resolution authorizing bond issue and purpose for which bonds may be issued. Either before or after the adoption of the plan as aforesaid, the governing board of any Mosquito Control District may pass a resolution (hereinafter sometimes referred to as "bond resolution") authorizing the issuance of bonds of the district. The negotiable bonds of a mosquito control district may be issued for the purchase of land and equipment, or any other property, real, personal, or mixed, to be used in carrying out the functions of the district, or for any other purpose consistent with the control of mosquitoes and other arthropods of public health significance.

Such resolution shall state:

1. In brief and general terms, the purpose for which the bonds are to be issued.

2. The maximum aggregate principal amount of the bonds.

3. That a tax sufficient to pay the principal and interest of the bonds when due shall be annually levied and collected on all taxable property within the district.

4. That the resolution shall take effect when and if it is approved by the voters of the mosquito control district at an election.

Such resolution shall be published once a week for three successive weeks: Provided, however, the first of such publications shall be not later than the first publication of the notice of election required in Section 11 of the Act. A statement in substantially the following form (the blanks being first properly filled in), with the printed signature of the secretary of the governing board of the district appended thereto, shall be published with the resolution:

The foregoing resolution was adopted by the governing board of _____ Mosquito Control District on the _____ day of _____, 19___, and was first published on the _____ day of _____, 19___. Any action or proceeding questioning the validity of said resolution must be commenced within thirty days after its first publication.

_____
Secretary, _____ Mosquito Control District.

Sec. 9. Limitation of action to set aside a bond resolution. Any action or proceeding in any court to set aside a bond resolution adopted pursuant to this Act, or to obtain any other relief upon the ground that such resolution is invalid, must be commenced within thirty days after the first publication thereof as provided in Section 8 of this Act.

After the expiration of such period of limitation, no right of action or defense founded upon the invalidity of the resolution shall be asserted, nor shall the validity of such resolution be open to question in any court upon any ground whatever.

Sec. 10. Publication of resolution, notice and statement. A resolution or notice or statement required by this Act to be published shall be published in a newspaper published in the county in which the district lies or if the district lies in two or more counties, in a newspaper published in each such county, or if there is no newspaper published in a county in which the whole or a part of the district lies, then and in lieu of a newspaper published in such county in a newspaper which, in the opinion of the governing board of the district, has general circulation within the district.

Sec. 11. Call for election. Following the adoption of a bond resolution by the governing board of the district, the said board shall call upon the board or boards of county commissioners in the county or counties in which the district or any portion thereof is located to name election officers, set date, name polling places, and cause to be held an election within the district on the proposition of issuing bonds as set forth in such bond resolution. If, at such election a majority of the registered voters who shall vote thereon at such election shall vote in favor of the proposition submitted, the bonds set forth in the bond resolution may be advertised, sold and issued in the manner provided by law. Should the proposition of issuing bonds submitted at any election as provided under this Act fail to receive the required number of affirmative votes, the governing board of the district may, at any time after the expiration of six months, cause another election to be held for the same objects and purposes or for any other objects and purposes. The expenses of holding bond elections shall be paid from the funds of the mosquito control district.

The board of commissioners of the county in which said mosquito control district is located, if wholly located in a single county, may in their discretion at any special election held under the provisions of this Act make the whole district a voting precinct, or may create therein one or more voting precincts as to them seems best to suit the convenience of voters, the said precinct not to be the general election precinct unless the boundaries of the mosquito district are coterminous with one or more whole general election precincts. If said district is located in more than one county, the election precincts therein shall be fixed by the board of the particular county in which the portion of the mosquito district is located.

The said board or boards of commissioners shall provide registration and polling books for each precinct in the mosquito control district, the cost of the same to be paid from the funds of the mosquito control district. The notice of the election shall be given by publication once a week for three successive weeks. It shall set forth the boundary lines of the district and the amount of bonds proposed to be issued. The first publication shall be at least thirty days before the election. At the first

election after the organization of the mosquito control district, a new registration of the qualified voters within the district shall be ordered and notice of such new registration shall be deemed to be sufficiently given if given at least thirty days before the close of the registration books by publication once in some newspaper published or circulated in said district. The notice of registration may be considered one of the three notices required of the election. Time of such registration shall as near as may be conform with that of the registration of voters in municipal elections as provided in G.S. 160-37. The published notice of registration shall state the days on which the books shall be open for registration of voters and the place or places at which they will be open on Saturday. The books of such new registration shall close on the second Saturday before the election. The Saturday before the election shall be challenge day and except as otherwise provided in this Act, such election shall be held in accordance with the law governing general elections.

A ballot shall be furnished to each qualified voter in said election, which ballot may contain the words "For approval of the bond resolution adopted by the Board of Mosquito Control Commissioners of _____ District on the _____ day of _____, 19____, authorizing the issuance of not exceeding $_____ of bonds of said district (briefly stating the purpose of such bonds), and the levy of a tax for the payment thereof, and the words "Against approval of the bond resolution adopted by the Board of Mosquito Control Commissioners of _____ District on the _____ day of _____, 19____, authorizing the issuance of not exceeding $_____ of bonds of said district (briefly stating the purpose of such bonds), and the levy of a tax for the payment thereof," with squares opposite said affirmative and negative forms of the proposition submitted to the voters, in one of which squares the voter may make a cross (X) mark, but this form of ballot is not prescribed. After the election and after the vote has been counted, canvassed and returned to the board or boards of county commissioners, the election books shall be deposited in the office of the clerk of the superior court as polling books for the particular mosquito control district involved. At any subsequent election, a new registration may or may not be ordered as may be determined by the board or boards of county commissioners interested in said election.

A statement of results of an election on the proposition of issuance of bonds showing the date of such election, the proposition submitted, the number of voters who voted for the proposition and declaring the result of the election shall be prepared and signed by a majority of the members of the governing board of the district and deposited with the clerk of the superior court of the county in which the district lies, or, if parts of the district lie in two or more counties, with the clerk of the superior court of each such county. Such statement shall be published once. No right of action or defense founded upon the invalidity of such election shall be asserted, nor shall the validity of the election be open to question in any court upon any ground whatever, except in an action or proceeding commenced within thirty days after the publication of such statement.

Sec. 12. Bonds. The governing board of the district shall, subject to the provisions of this Act, and under competent legal and financial advice, prescribe by resolution the form of the bonds, including any interest coupons to be attached thereto, and shall fix the date, the maturities, the denomination or denominations, and the place or places of payment of principal and interest which may be at any bank or trust company within or without the State of North Carolina. The bonds shall not be sold at less than par and accrued interest nor bear interest at a rate or rates in excess of six per centum (6%) per annum. The bonds shall be signed by the chairman and secretary of the governing board of the district, and the seal of the governing board shall be impressed thereon, and any coupons attached thereto shall bear a facsimile of the signature of the secretary of said governing board in office at the date of the bonds or at the date of delivery thereof. The delivery of bonds so executed shall be valid, notwithstanding any change in officers or in the seal of the governing board occurring after the signing and sealing of the bonds. Bonds issued under this Act shall be payable to bearer unless they are registered as hereinafter provided, and each coupon appertaining to a bond shall be payable to the bearer of the coupon. A mosquito control district may keep in the office of the secretary of the governing board, or in the office of a bank or trust company appointed by said governing board as bond registrar or transfer agent, a register or registers for the registration and transfer of its bonds, in which it may register any bond at the time of its issue or, at the request of the holder, thereafter. After such registration, the principal and interest of the bond shall be payable to the person in whose name it is registered except in the case of a coupon bond registered as to principal only, in which case the principal shall be payable to such person, unless the bond shall be discharged from registration by being registered as payable to bearer. After registration a bond may be transferred on such register by the registered owner in person or by attorney, upon presentation to the bond registrar, accompanied by delivery of a written instrument of transfer in a form approved by the bond registrar, executed by the registered owner. Upon the registration or transfer of a bond as aforesaid, the bond registrar shall note such registration or transfer on the back of the bond. A mosquito control district may, by recital in its bonds, agree to register the bonds as to principal only, or agree to register them either as to principal only or as to both principal and interest at the option of the bondholder. Upon the registration of a coupon bond as to both principal and interest the bond registrar shall also cut off and cancel the coupons, and endorse upon the back of such bond a statement that such coupons have been canceled. The proceeds from the sale of such bonds shall be placed in a bank in the State of North Carolina to the credit of the governing board of the district, and payments therefrom shall be made by vouchers signed by the chairman and secretary of the governing board. The officer or officers having charge or custody of funds of the district shall require said bank to furnish security for the protection of deposits of the district as provided in G. S. 159-28. Bonds issued pursuant to this Act shall be subject to the provisions of the Local Government Act. The cost of preparing, issuing, and marketing bonds shall be deemed to be one of the purposes for which the bonds are issued.

Sec. 13. If any provision of this Act, or the application thereof to any person or circumstance, is held invalid, the remainder of the Act, or the application of such provision to other persons or circumstances, shall not be affected thereby.

Sec. 14. All laws and clauses of laws in conflict herewith are hereby repealed.

Sec. 15. This act shall be in full force and effect from and after its ratification.

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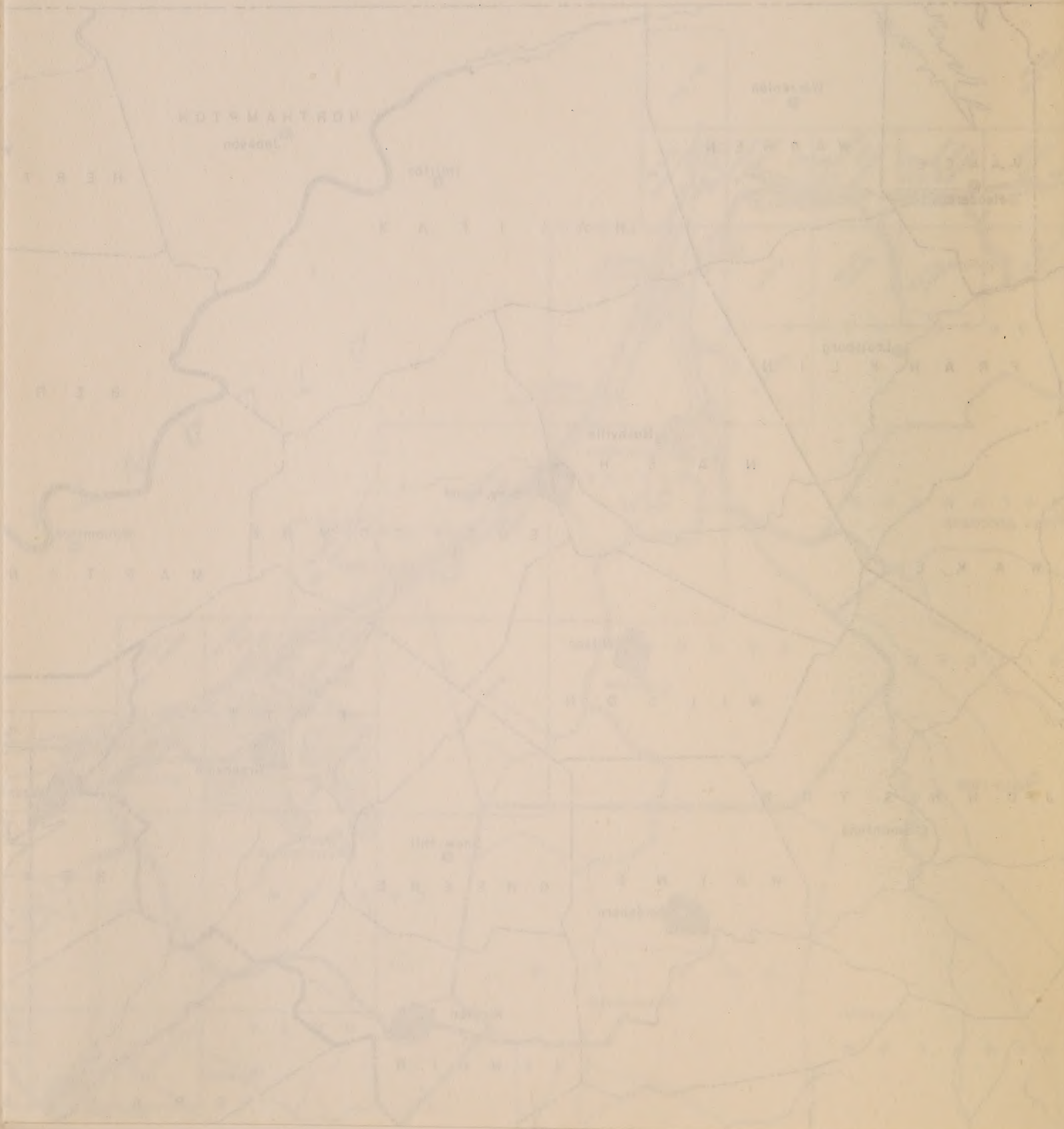
MAP SHOWING
SALT MARSH AREAS AND COUNTIES AFFECTED BY SALT MARSH MOSQUITOES IN NORTH CAROLINA

SCALE OF MILES
0 10 20

PREPARED BY
NORTH CAROLINA SALT MARSH
MOSQUITO STUDY COMMISSION
NOVEMBER 1956

LEGEND

- Salt Marsh Areas
- Boundary Of Counties Having Salt Marsh Mosquito Problems
- U.S. Geological Quadrangle Maps Showing Acres Of Salt Marsh

ATLANTIC OCEAN